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# Structural Steel and Timber Design SAB3233

## Topic 1
## Structural Design – an overview

Prof Dr Shahrin Mohammad





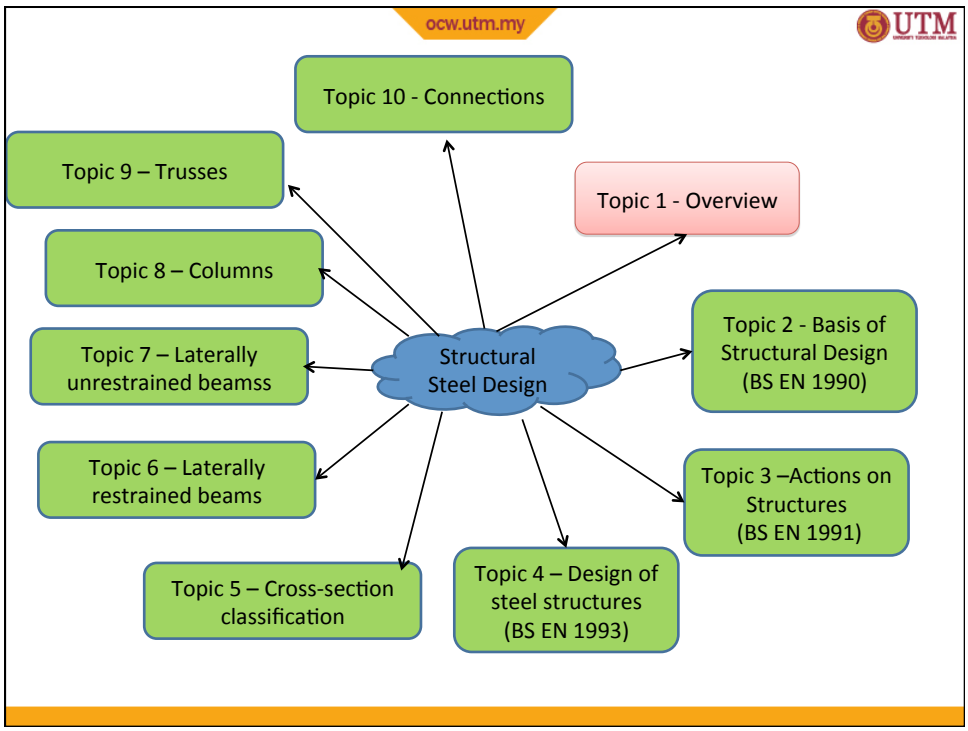


### About Myself

Dean Faculty of Civil Eng 2009- present
Chairman, Society of Engineering Education Malaysia 2011-2012
Chairman, Engineering Deans Council, UTM
Associate Director for Engineering Accreditation Dept
Group Secretary Academic Performance Audit Panel
Head Computer Lab 1988 – 1990
Head of Dept (Structures and Materials) 1997 – 1998
IT Manager 1998 - 2001
Deputy Dean (Academic) 2001-2005
Quality Mgt Rep ISO 9001:2000 2001-2005
Academic Quality Director of UTM 2005-2007
Deputy Dean (Academic) 2008-2009
Certified ISO 9001:2000 Lead Auditor,
Facilitator/Trainer ISO 9001:2000, Internal Auditor
Engineering Accreditation Council Panel of Trainers
Ministry of Higher Education - facilitator on MQF Credit System
Facilitator/Trainer on Outcome based Approach
Facilitator/Trainer on Quality Assurance for Academic Programme
Facilitator/Trainer on Academic Auditing

| No. | Course Learning Outcomes | Programme Outcome(s) | Taxonomies and Soft-Skills | Assessment Methods |
|---|---|---|---|---|
| 1. | **Describe** the concept and philosophy of steel and timber design based on the relevant code of practice | PO1 | C1 | T, PR, F |
| 2. | **Estimate** the design loadings and to analyse structural elements correctly | PO1, PO2, PO3 | C3 | T, PR, F |
| 3. | **Use** the code of practise to design structural steel and timber elements. | PO1, PO2, PO3 | C5 | T, PR, F |
| 4. | **Prepare** structural design report, drawing plan and structural element detailing before week 15 | PO3 | P4, A4 | PR |
| 5. | **Work** effectively in a team producing a design report within a stipulated timeframe | PO7 | P4, A4, TS1, TS2, TS3, | Peer assessment and |





Steel : metal with 95% or more iron. The remaining constituents are small amounts of elements derived from the raw materials used in the making of the steel, as well as other elements added to improve certain characteristics or properties of the product.

Structure : one or more elements arranged in certain form to resist the forces stably and with no excessive deformation.

Structural steel : steel in various shapes and forms utilized to support loads and resist the various forces to which a structure is subjected.



Structural design is a process by which an optimum solution is obtained meeting certain established criteria.

Aims of Structural Design

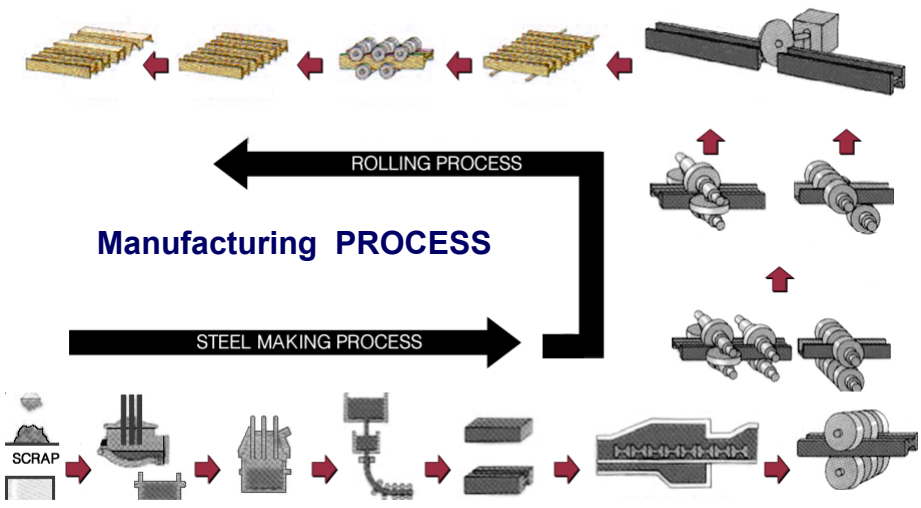
- to fulfil its intended function
- to sustain the specified loads for its intended life
- to consider the economical aspect

1. The design should facilitate safe fabrication, transport, handling and erection.
2. It should take account of the needs of future maintenance, final demolition, recycling and reuse of materials

Why steel?

1. High strength – The high strength of steel per unit of weight means dead loads will be small. This fact is of great importance for long-span bridges, tall buildings, and for structures having poor foundation condition.
2. Uniformity – The properties of steel do not change appreciably with time as do those of a reinforced concrete structure.
3. Elasticity – Steel behave closer to design assumptions than most materials because it follows Hooke's law up to fairly high stress.
4. Ductility – It can withstand extensive deformation without failure under high tensile stresses. It is free from sudden failure. The large deflection occurred when it overloaded gives visible evidence of impending failure ('time for run').
5. Additions to existing structures – New bay or even new wings can be added to existing steel frame building.
6. Time saving – Due to no curing time and scaffolding time, the speed of steel construction far faster than the concrete construction.
7. Flexibility in fabrication - The section geometry, strength, and other properties could be controlled flexibly and accurately.
8. The after-demolished value – Steel is highly reusable, the scrap value is also high even though not reusables in its existing form.





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# Structural Steelwork in action

Introduction

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THE AMPLE PARK SOLUTION


Aims of Structural Design

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Aims of Structural Design

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Aims of Structural Design

## Aims of Structural Design



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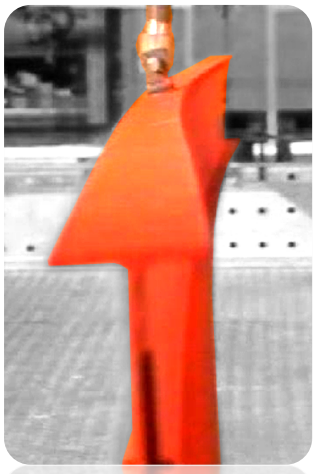

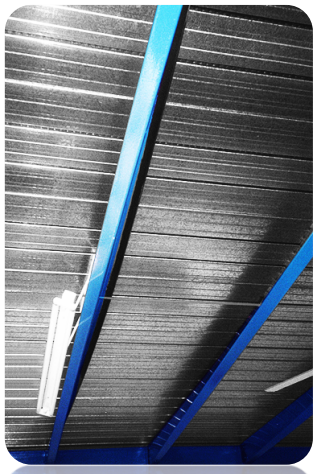

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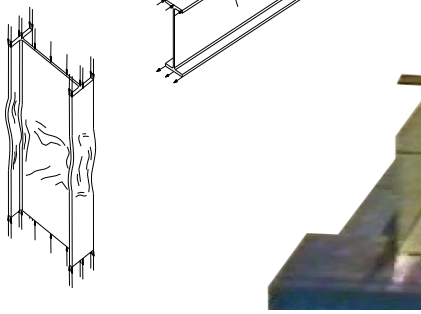
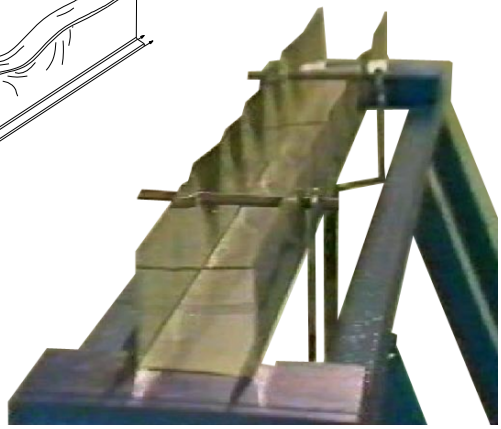
## Aims of Structural Design











Aims of Structural Design

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Aims of Structural Design

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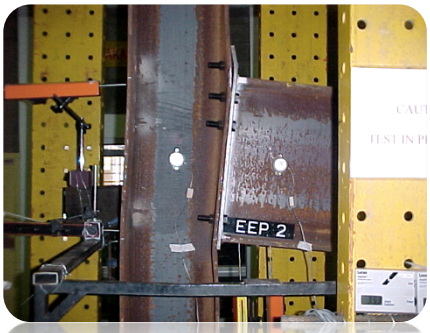


Aims of Structural Design

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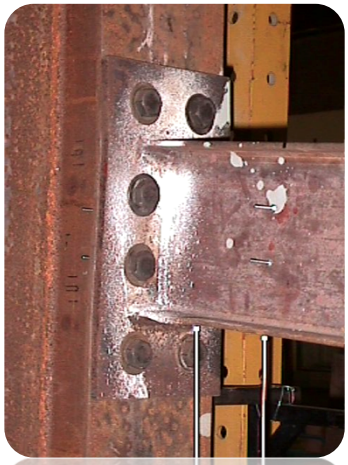

Aims of Structural Design

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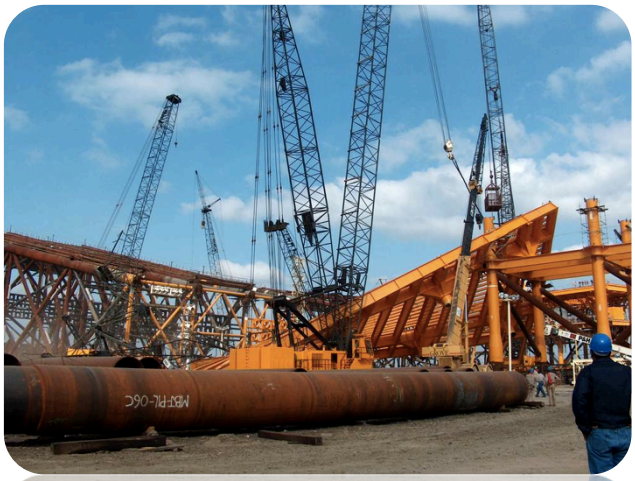

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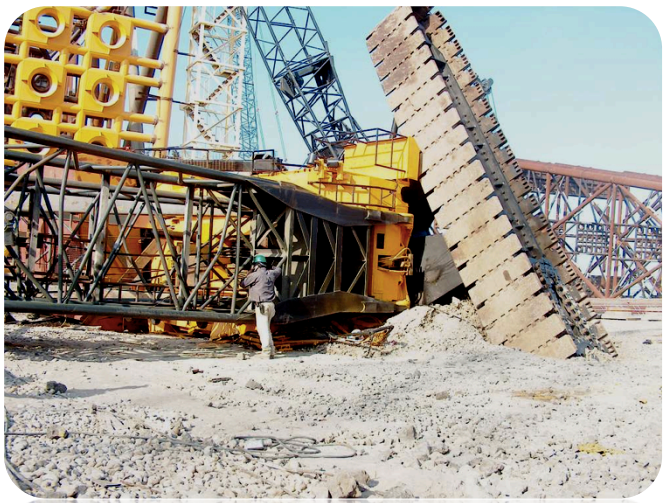




Methods of design :

1. Simple Construction The joints should be assumed not to develop moments adversely affecting either the members or the structure as a whole.
2. Rigid Construction The joints should also be capable of resisting the moments and forces resulting from the analysis.
3. Semi-Continuous Construction The joints have some degree of strength and stiffness, but insufficient to develop full continuity.

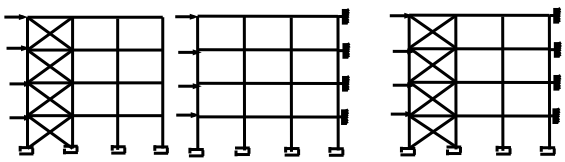
## Braced Steel Frame

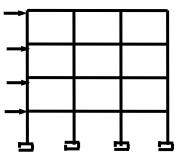
| Simple | Semi-continuous | Continuous |
|---|---|---|
| - connections between members are assumed not to develop moments<br>- joint pin connected<br>- necessary to maintain stability against sway<br>- elastic analysis | - some degree of connection stiffness is assumed<br>- joint semi-rigidly connected<br>- Limitation in the design specifications | - connections between members capable to develop full strength/stiffness<br>- joint rigidly connected<br>- elastic analysis or plastic analysis |

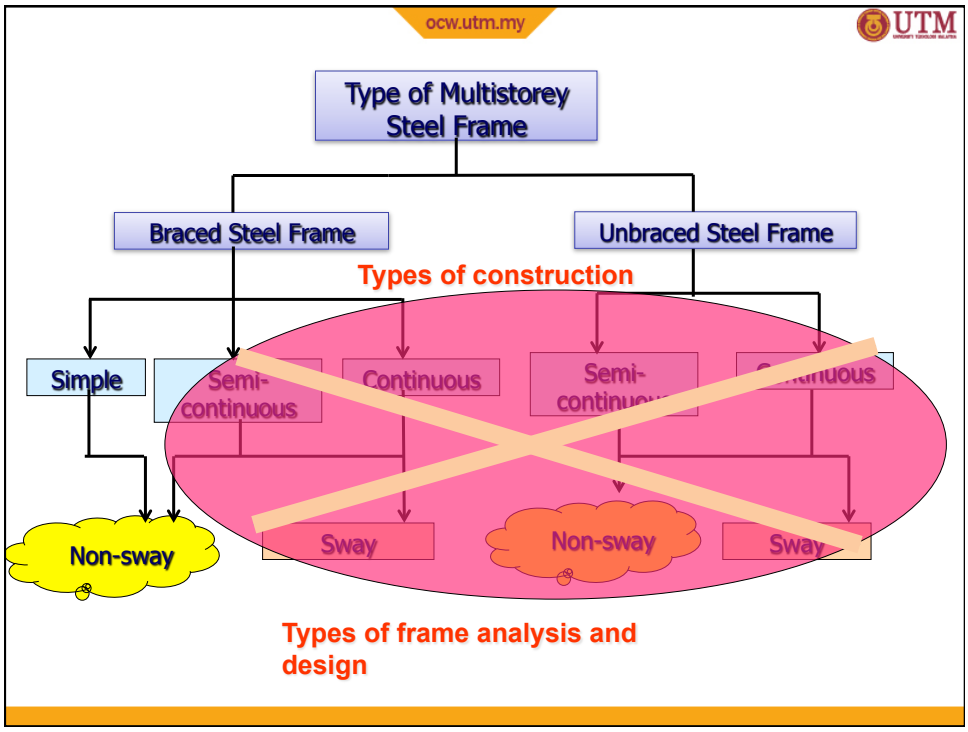


## Types of Multistorey Steel Frame

- **Braced Steel Frame** — Horizontal loads are carried by the bracing or by horizontal support
- **Unbraced Steel Frame** — Horizontal forces are carried by the frame



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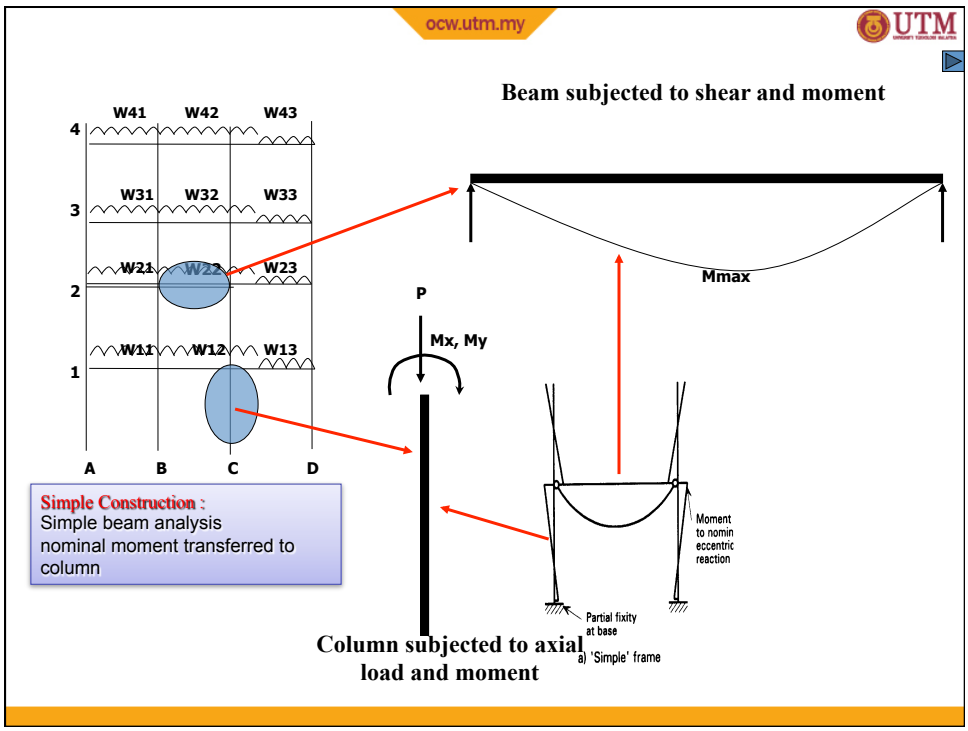
Type of Multistorey Steel Frame
Braced Steel Frame
Unbraced Steel Frame
Types of construction
Simple
Semi-continuous
Continuous
Semi-continuous
Non-sway
Sway
Non-sway
Sway
Types of frame analysis and design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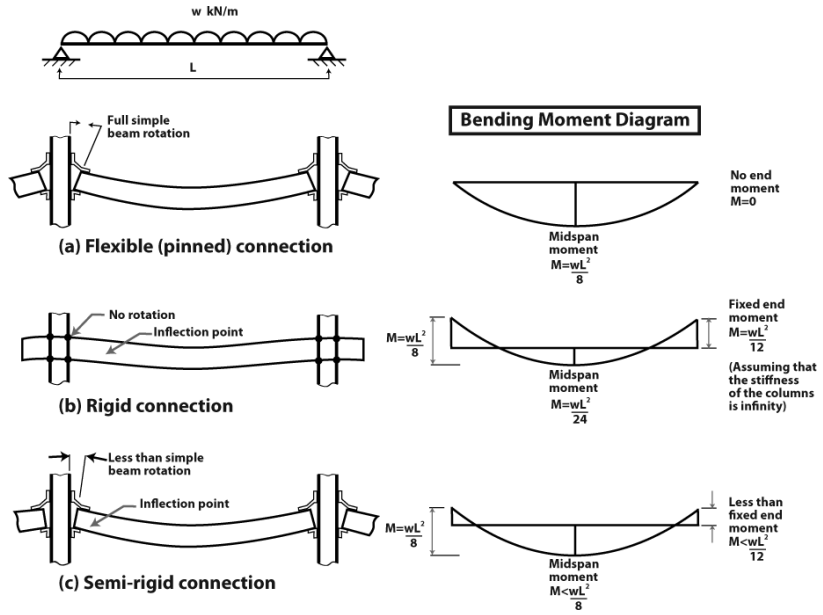
Beam subjected to shear and moment
W41 W42 W43
W31 W32 W33
W21 W22 W23
W11 W12 W13
4
3
2
1
A B C D
Mmax
P
Mx, My
Simple Construction :
Simple beam analysis
nominal moment transferred to column
Moment to nomin eccentric reaction
Partial fixity at base
a) 'Simple' frame
Column subjected to axial load and moment

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Thank You