

Structural Engineering Documents

13

**Use of Timber in Tall
Multi-Storey Buildings**



International Association for Bridge and Structural Engineering (IABSE)

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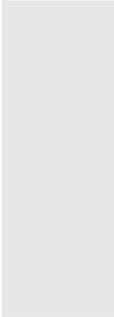
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Preface

Much has been written in the last few decades about the relative merits of alternative materials for building construction. As part of such efforts, this Structural Engineering Document (SED) provides guidance to engineers on how to properly design multi-storey buildings that incorporate timber and timber-based products as superstructure elements. The scope encompasses traditional systems for buildings up to 10 storeys made from conventional timber products and innovative systems that employ modern timber-based composites, as well as emerging possibilities for using timber elements in very tall buildings.

Poor building performance is usually accompanied by a failure to integrate design across all aspects of a project; or a failure to link design concepts with the realities of local construction and maintenance practices. For example, if timber elements are not properly protected from wetting (i.e. more than occasionally wetted at rates that exceed ambient drying rates), they are unlikely to be durable. However, if they are protected adequately, timber elements are likely to retain their initial properties for centuries. This document emphasises attainment of Total Performance Goals on a cradle to grave basis, taking account of structural and non-structural considerations. In the contemporary parlance, structural design decisions must support attainment of Total Performance Goals from cradle to grave. Even though the lifespan of most buildings are indeterminate at the time of their conception, their design and construction must address issues like capability of the fabric to retain integrity up to and beyond the likely lifespan and eventual dismantling.

The intended audience for this SED is structural engineering practitioners, construction professionals, academic researchers, code drafting bodies, and students. However it is hoped that there will be ancillary audiences amongst architects, property developers, town planners, and governmental policy makers.

Ian Smith
Andrea Frangi

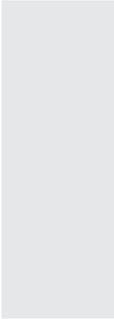


Table of Contents

1	Introduction	1
1.1	Historical use of timber for construction	1
1.2	Modern renaissance of timber as a construction material	5
1.3	Other chapters	6
2	Structural Design Issues	9
2.1	Introduction	9
2.2	Design practices and assumptions	11
2.2.1	Load combinations, load factors, and resistance factors	12
2.2.2	Achieving an elastic response and allowance of damage	13
2.2.2.1	Factors to consider	13
2.2.2.2	Recommended design practices	15
2.2.3	Analysis methods	18
2.3	Effect of superstructure shape and height	18
2.4	Importance of horizontal diaphragms	20
2.5	Acceptable risk levels and avoidance of disproportionate damage	21
2.5.1	Risk	21
2.5.2	Mitigating damage potential	21
2.6	Podium and other constructed systems with articulated dynamic responses	23
2.7	Additional comments	24
3	Fire Design Concepts	25
3.1.	Introduction	25
3.2.	Fire action	26
3.3.	Fire safety objectives and strategy	27
3.4.	Fire resistance of structural timber elements	28
3.5.	Design model for the verification of the separating function	30
3.6.	Fire design concept for tall timber buildings	36
3.6.1	Main differences between mid-rise and tall buildings with regard to fire safety	38
3.6.2	Is it still possible to design a tall building using timber as structural material?	38
3.7.	Example of tall building project	39
3.8.	Experimental studies	40
3.8.1	Fire performance of timber structures under natural fire conditions	40

3.8.2	Results of sprinklered fire tests	41
3.8.3	Results of non-sprinklered fire tests	41
3.9.	Additional comments	44
4	Durability Design Concepts	45
4.1	Introduction	45
4.2	State-of-the-art	46
4.3	Attack mechanisms	48
4.3.1	Mould	48
4.3.2	Decay	48
4.3.3	Termites	50
4.3.4	Corrosion	50
4.4	Design strategies	51
4.4.1	Non-structural elements	51
4.4.2	Non-critical structural elements	52
4.4.3	Critical structural elements	52
4.5	Calculation of engineered service life	53
4.5.1	Australian approach	53
4.5.2	Example calculation	54
4.6	Additional comments	55
	Acknowledgements	56
5	Timber Frameworks with Rigid Diaphragms: Special Considerations	57
5.1	Introduction	57
5.2	Useful lessons from low-rise timber construction (circa less than 20 m tall)	58
5.3	Modern renaissance tall timber frame systems (circa 20–80 m tall)	61
5.4	Effective connection methods	64
5.5	Additional comments	69
	Acknowledgements	69
6	Steel or Reinforced Concrete Frameworks with Timber Diaphragms: Special Considerations	71
6.1	Introduction	71
6.2	Massive timber diaphragms for composite hybrid systems	72
6.3	Twenty-four-storey case studies	72
6.3.1	Scope and methods	72
6.3.2	Case study results	76
6.3.2.1	Structural steel framework systems	76
6.3.2.2	RC framework systems	78
6.4	General implications of using CLT slabs	81
6.5	Additional comments	82
	Acknowledgements	83
7	Platform Construction Using Timber Plates: Special Considerations	85
7.1	Introduction	85
7.2	CLT as structural material	86
7.2.1	General characteristics	86
7.2.2	Typical design properties	87
7.3	Platform construction concept	88
7.4	Connection methods	89
7.5	Structural analysis and design	92

7.5.1	General aspects	92
7.5.1.1	Basis of analysis and design	92
7.5.1.2	Load paths and robustness	92
7.5.1.3	Design of floors	94
7.5.1.4	Design of walls	95
7.5.1.5	Design of connections	97
7.5.2	Expected performance during seismic events	98
7.5.3	Design manuals	100
7.6	Example of seismic design practices	100
7.6.1	Background	100
7.6.2	Seven-storey case study	101
7.7	Additional comments	106
	Acknowledgements	107
8	Example Project 1: Six-Storey Hybrid Building in Quebec City, Canada	109
8.1	Background	109
8.2	Superstructure system	110
8.2.1	Description and construction	110
8.2.2	Glulam framework and diaphragms	112
8.2.3	Timber connection methods	114
8.3	Structural Design	116
8.3.1	General aspects	116
8.3.2	Project specific considerations	117
8.3.3	Analysis method and design results	118
8.4	Fire design	119
8.5	Measurement of the building response	120
8.5.1	Differential movements	120
8.5.2	Vibration response	121
8.6	Additional comments	122
	Acknowledgements	123
9	Example Project 2: Fire Design of a Seven-Storey Hybrid Building in Berlin, Germany	125
9.1	Background	125
9.2	Description of the building superstructure	125
9.3	Fire compartmentalization of the building	127
9.4	Detailed aspects of the design	129
9.4.1	Floor slabs	129
9.4.2	Critical element junctions	131
9.4.3	Gravity load system	132
9.4.4	Cavity fires and transmission of hot gases	133
9.5	Additional comments	133
	Acknowledgements	134
10	Example Project 3: Linnologen—Block of Four Eight-Storey Residential Buildings in Växjö, Sweden	135
10.1	Background	135
10.2	Architectural design	136
10.3	Structural design	137
10.3.1	Wall elements	137
10.3.2	Floor elements	138

10.3.3 Lateral load design	139
10.4 Fire design	139
10.5 Acoustical design	140
10.6 Protection of elements and construction of buildings	140
10.6.1 Moisture and weather protection	140
10.6.2 Construction of buildings	140
10.7 Research studies	142
10.7.1 Measurements of vertical settlement	143
10.7.2 Time study on installation of load-bearing elements	145
10.8 Additional comments	146
Acknowledgements	146
11 Example Project 4: Björkbacken, a 10-storey hybrid building in Stockholm, Sweden	147
11.1 Background	147
11.2 Superstructure concept	148
11.3 Fire compartmentalization	150
11.4 Vertical load resisting system	150
11.5 Lateral load resisting system	151
11.6 Construction of building	151
11.7 Additional comments	153
Acknowledgements	153
12 Looking to the Future	155
12.1 Likely limits on heights of multi-storey superstructure systems	155
12.1.1 Lightweight timber plate assemblies	156
12.1.2 Massive timber plate assemblies	158
12.1.3 Heavyweight timber-framed assemblies	159
12.1.4 Hybrid/composite assemblies	161
12.2 Example of proposed systems: <i>LifeCycle Tower</i> concept	163
12.3 Refocusing design codes	167
12.3.1 General requirements	167
12.3.2 Timber structural design	168
12.3.3 Timber fire design	169
12.4 Final comments	169
Acknowledgements	169
13 References	171

Introduction

***Summary:** Since the dawn of civilization, timber has been a primary material for achieving great structural engineering feats. Yet during the late 19th century and most of the 20th century it lost currency as a preferred material for construction of large and tall multi-storey building superstructures. This Structural Engineering Document (SED) addresses a reawakening of interest in timber and timber-based products as primary construction materials for relatively tall, multi-storey buildings. Emphasis throughout is on the holistic addressing of various issues related to performance-based design of completed systems, reflecting that major gaps in know-how relate to design concepts rather than technical information about timber as a material. Special consideration is given to structural form, fire vulnerability, and durability aspects for attaining desired building performance over lifespans that can be centuries long. This chapter discusses the historical use of timber as a high-performance construction material and lays the groundwork for detailed discussion of modern practices and possibilities in other chapters.*

1.1 Historical use of timber for construction

Evidence has been found that in Neolithic China the pre-human species “Peking Man” constructed “nest residences” from branches and thatch. Earth was compacted around thick timber struts, and it is speculated that this was to prevent them from catching fire [1]. Although the practices were crude, this arguably means that timber engineering (structural use of timber) and fire engineering (control of fire risk) were born between 300 000 and 1 million years ago and predate humans. Similarly, carpentry skills that are the basis of modern ability to interconnect timber members have ancient origins. Stone Age people created load-bearing building systems that interconnected timbers using mortise-and-tenon joints that are the direct forerunner of traditional Chinese architecture [1].

From antiquity onwards, urban utilization of construction materials has been shaped by their fire performance when assembled into buildings. City-wide or district-wide conflagrations were the impetus for prescriptive building regulations that date back to the Roman Empire [2]. More modern catastrophes like The Great Fire of London in 1666 and The Boston Fire in 1872 have reinforced fear of urban fires, and many specific building code restrictions created between 17th and 19th centuries are recognizably alive today in some jurisdictions (e.g. not allowing timber buildings to have more than four storeys above ground). Historical building regulations

Structural Engineering Documents

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