

# 轻型竹结构

# Lightweight Glulam Structures

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# Table of Content

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## **1. Research Background**

2. Glubam: Structural & Engineered Laminated Bamboo

3. Connections, Structural Elements of Glubam and Its Design Method

4. Experimental Research on Glubam Structures

5. Application of BIM on Glubam Structures: Design & Management

6. Case Study

# 1. Background: what we are doing?

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Lightweight Glulam house in LeiYang, **mountain areas**, 2009



Lightweight Glulam house in Changsha, **university campus**, 2009



Lightweight Glulam meeting room in Kenya, **all materials from China**, 2011.



**Solar-Glulam house** in Changsha, university campus, 2010

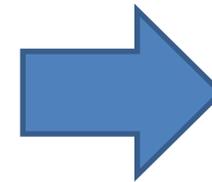
# 1. Background: why Glubam structures?

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1. NOW



2. Future



YES

# Table of Content

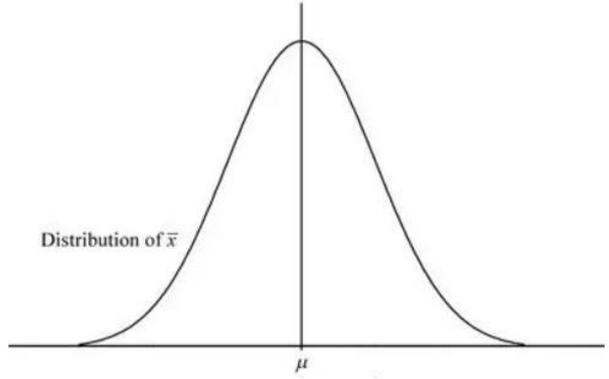
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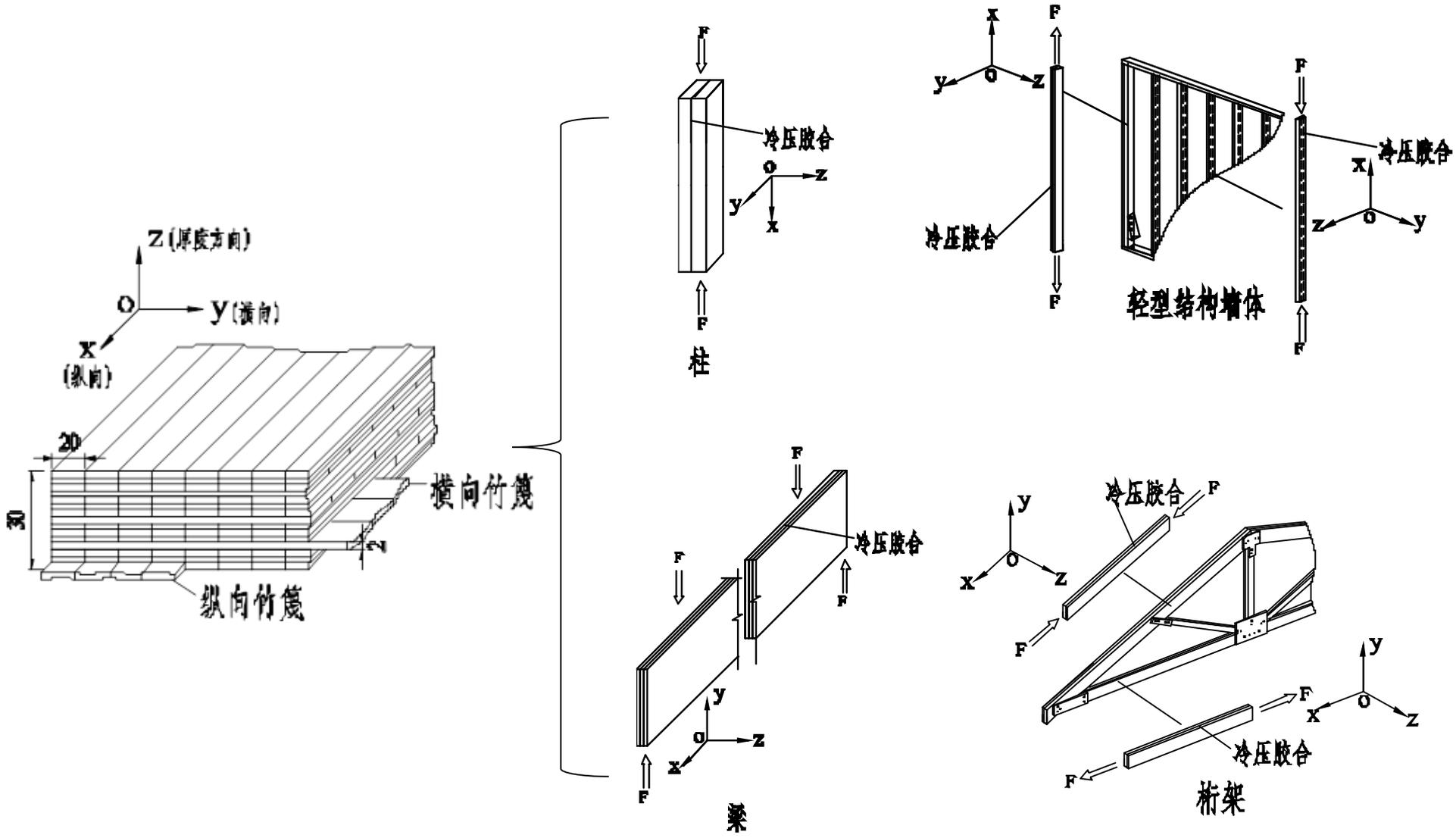
# Glubam: structural & engineered laminated bamboo



Structural & Engineered →

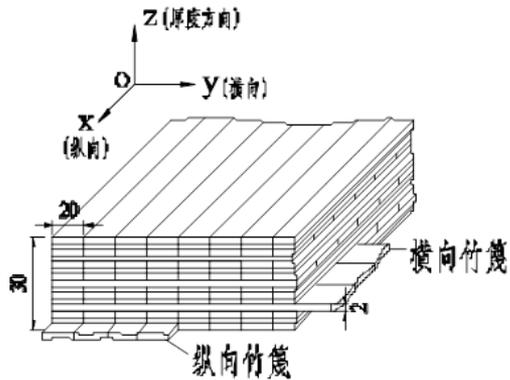


# Mechanical properties of Glulam



Tensile		compression		bending	
$n=16$		$n=26$		$n=32$	
$f_{t,ox}=83$ MPa	$\sigma=16$ MPa	$f_{m,oz}=51$ MPa	$\sigma=2.6$ MPa	$f_{m,oz}=99$ MPa	$\sigma=12$ MPa
$f_{t,oy}=17$ MPa		$f_{m,oy}=26$ MPa	$\sigma=3$ MPa	$f_{m,oy}=24$ MPa	$\sigma=6$ MPa
shear			$n=62$		
$\tau_{xy}=14.74$ MPa	$\sigma=1.89$ MPa	$\tau_{zy}=3.08$ MPa	$\sigma=1.07$ MPa	$\tau_{yx}=16.00$ MPa	$\sigma=2.16$ MPa
$\tau_{zx}=4.61$ MPa	$\sigma=1.39$ MPa				

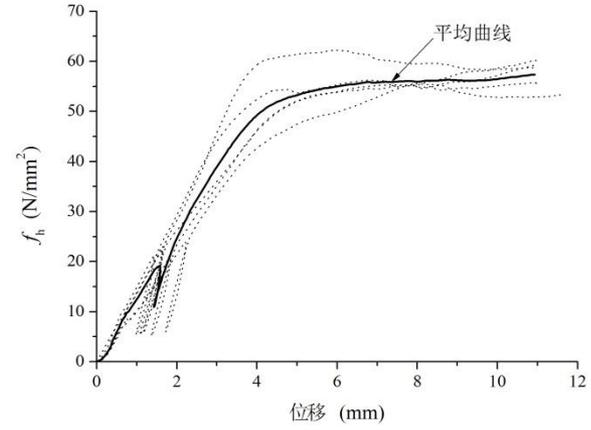
备注:1.  $\tau_{xy}$  表示剪切错动面平行于YOZ平面, 并沿Y方向;



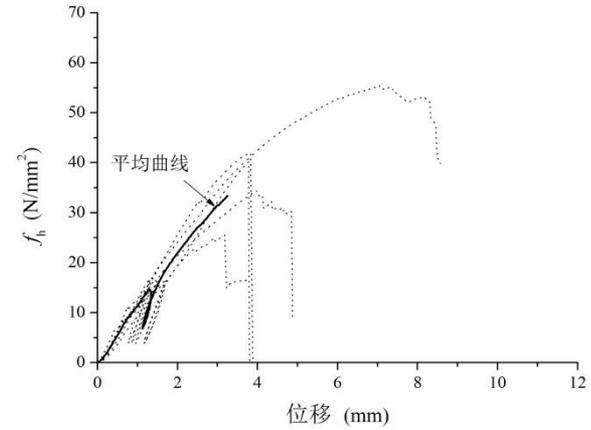
# Embedment strength



## Main fiber direction



## Less fiber direction

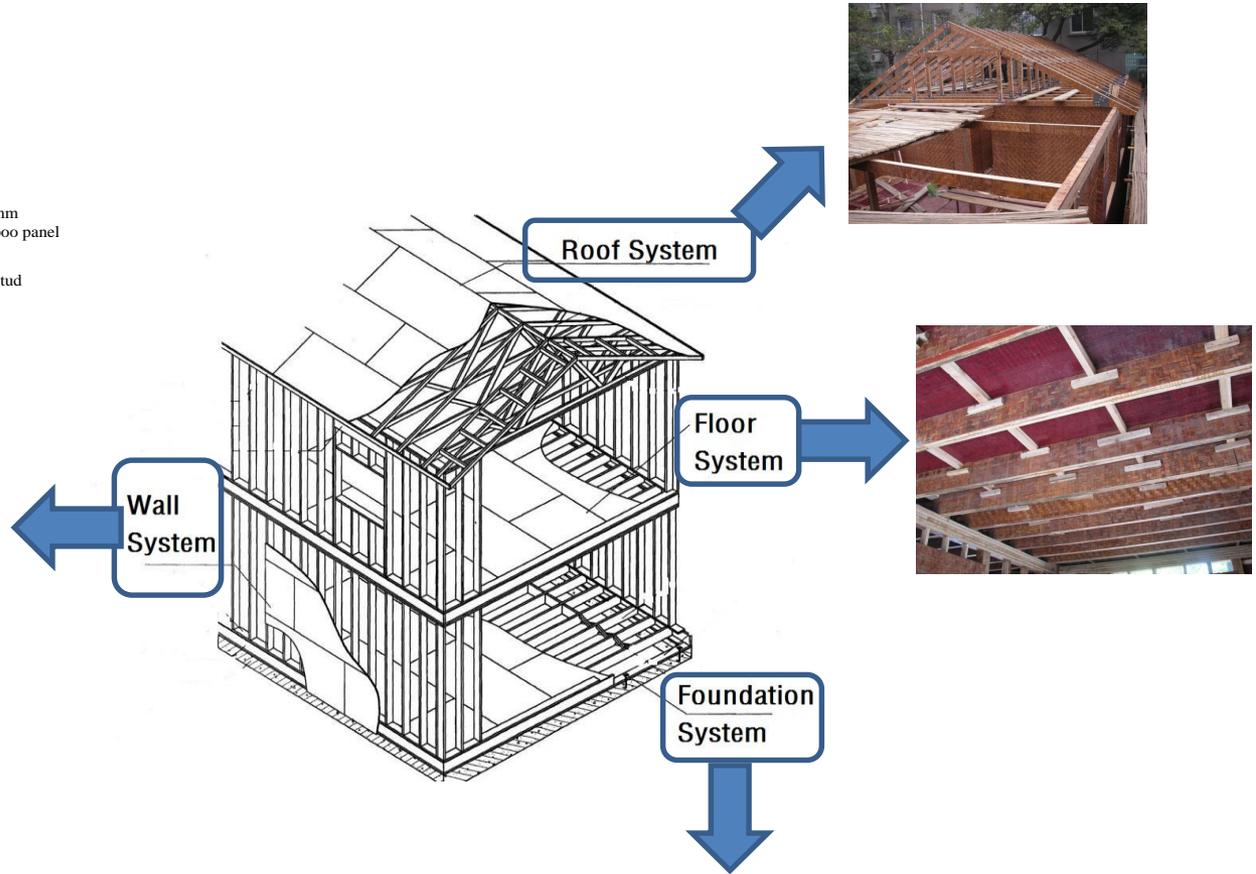
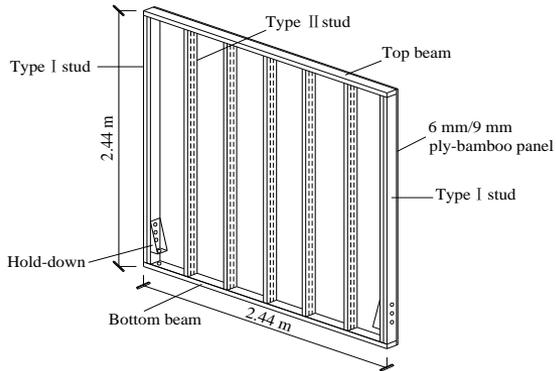


# Table of Content

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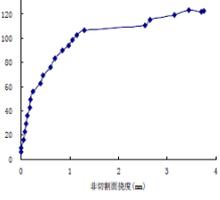
1. Research Background
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5. Application of BIM on Glubam Structures: Design & Management
6. Case Study

# 3. Structural Elements of Glulam and Its Design Method

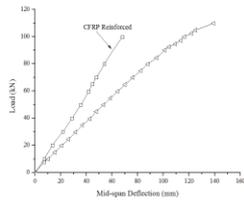


# Research on Structure elements / 结构构件层面的研究情况

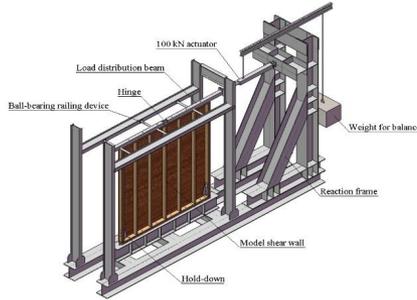
## Column



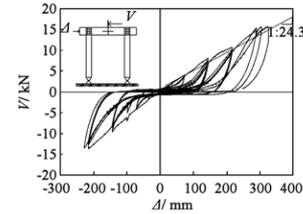
## Beam



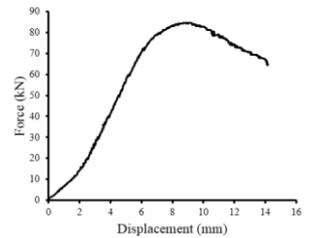
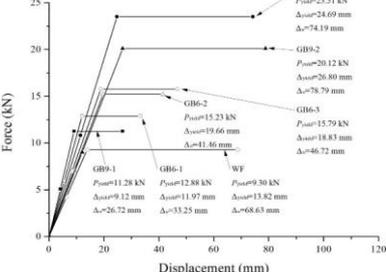
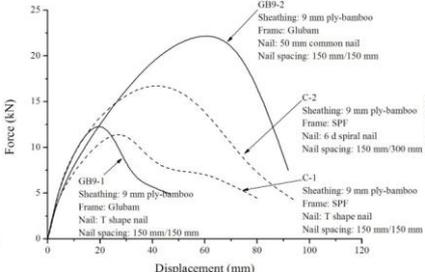
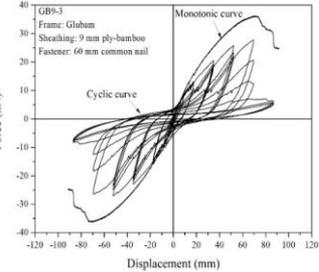
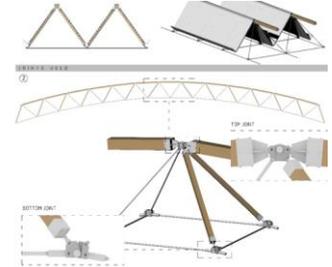
## Shear wall



## Portal frame



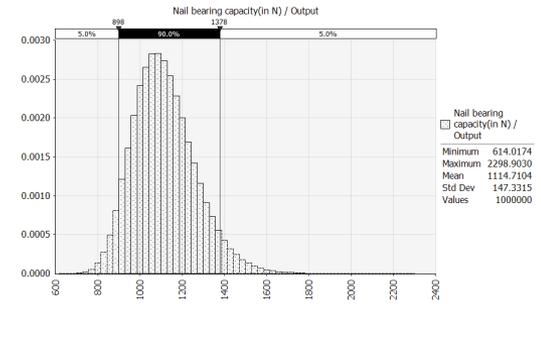
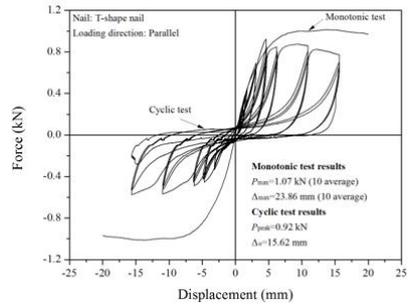
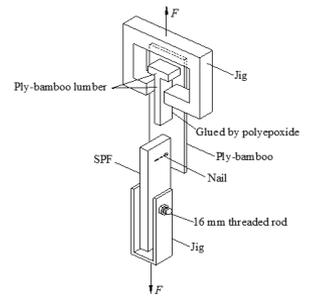
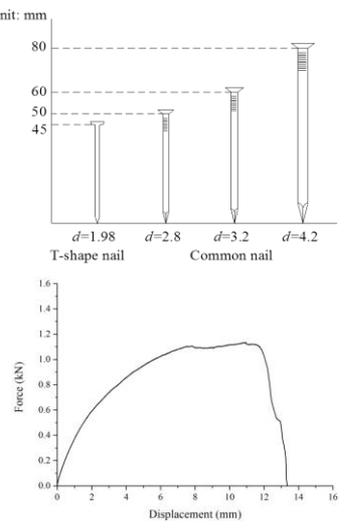
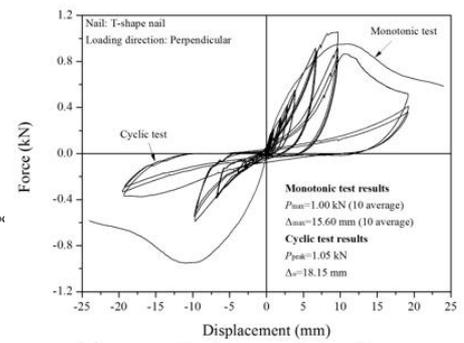
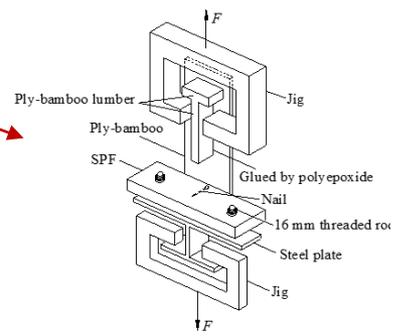
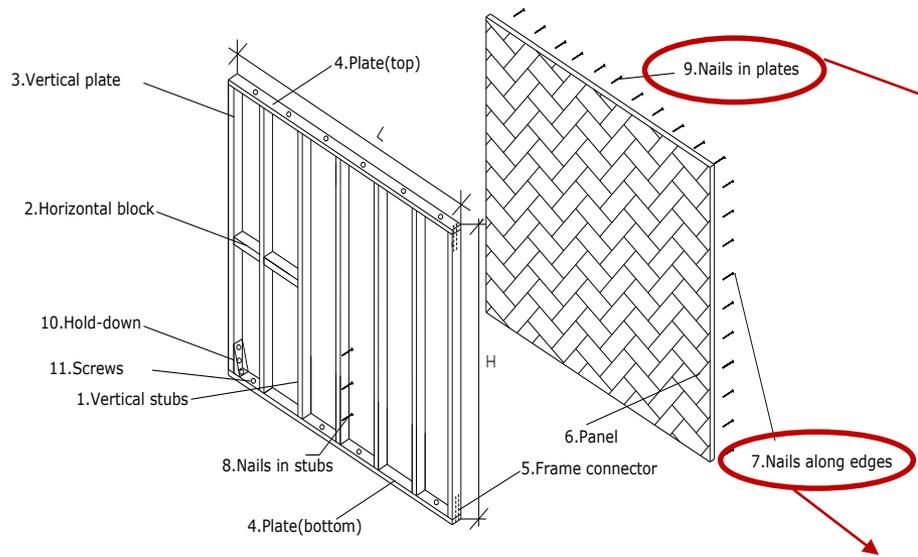
## Roof truss



# Foundations



# Panel-frame connections in shear walls / 剪力墙的连接件



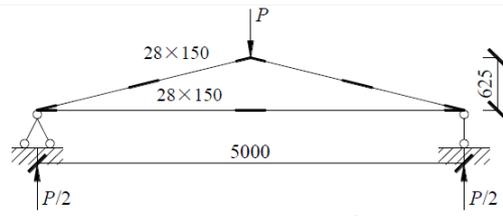


# Floor diaphragm

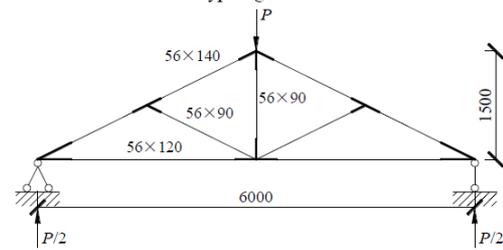
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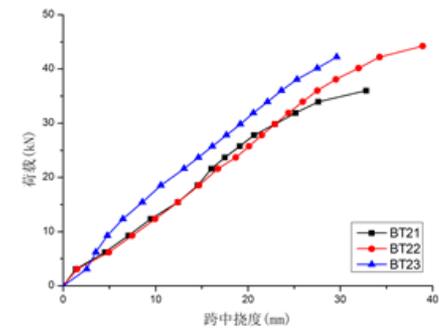
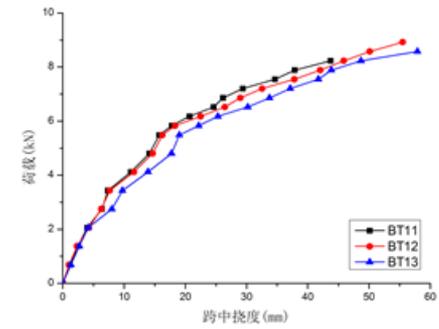
# Roof



a. Type I glulam roof



b. Type II glulam roof



# Table of Content

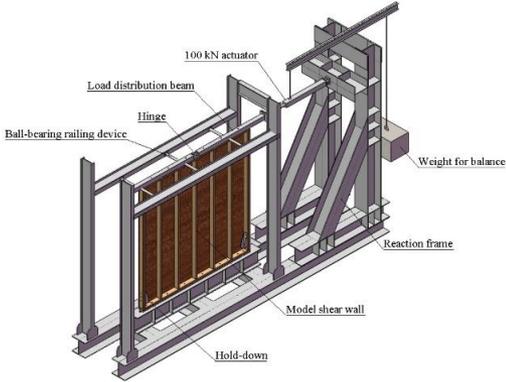
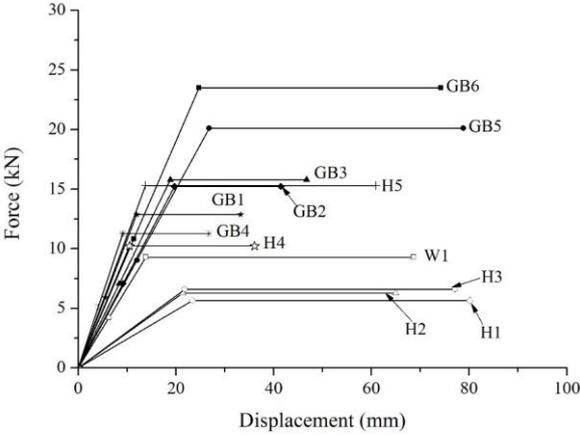
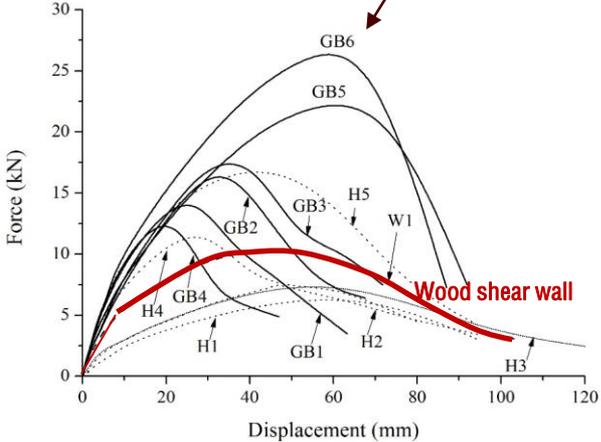
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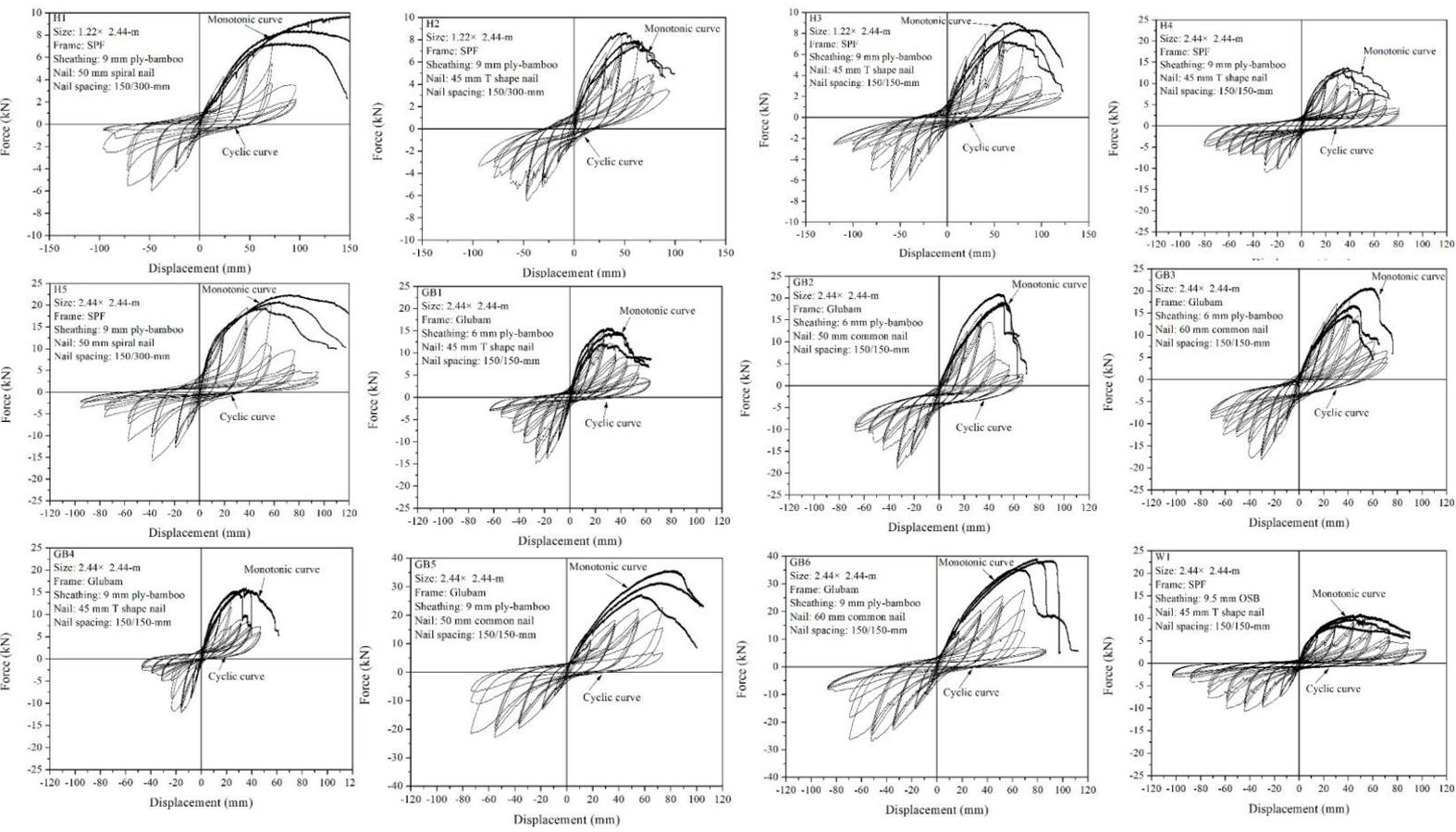
# Lightweight (timber-) bamboo shear walls

Test matrix of the shear walls

Group	Wall size (m)	Frame	Sheathing	Nail	Nail spacing (mm)
H1	1.22 × 2.44	SPF	9 mm ply-bamboo	50 mm spiral nail	150/300
H2				45 mm T shape nail	
H3					50 mm spiral nail
H4				45 mm T shape nail	
H5	2.44 × 2.44	Glulam	6 mm ply-bamboo		45 mm T shape nail
GB1				50 mm common nail	
GB2			60 mm common nail		
GB3			45 mm T shape nail		
GB4	9 mm ply-bamboo	50 mm common nail	60 mm common nail	45 mm T shape nail	
GB5					
GB6				60 mm common nail	
W1		SPF	9.5 mm OSB	45 mm T shape nail	



# Lightweight bamboo shearwall



Experimental database has been obtained for such shear walls, more analytical work will be conducted.

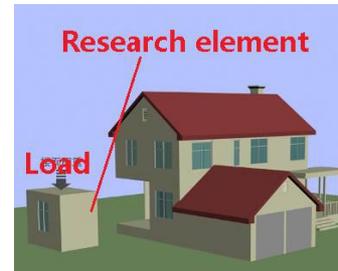
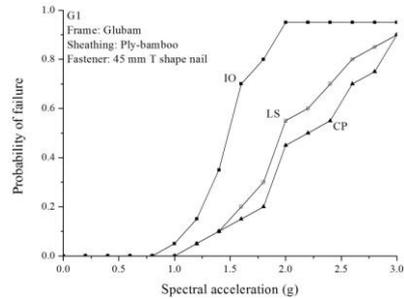
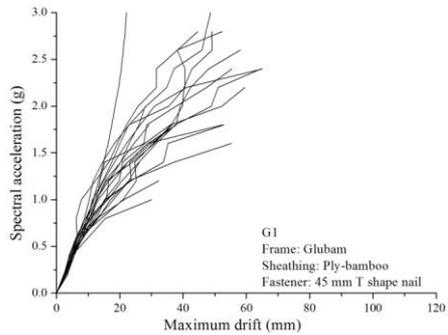
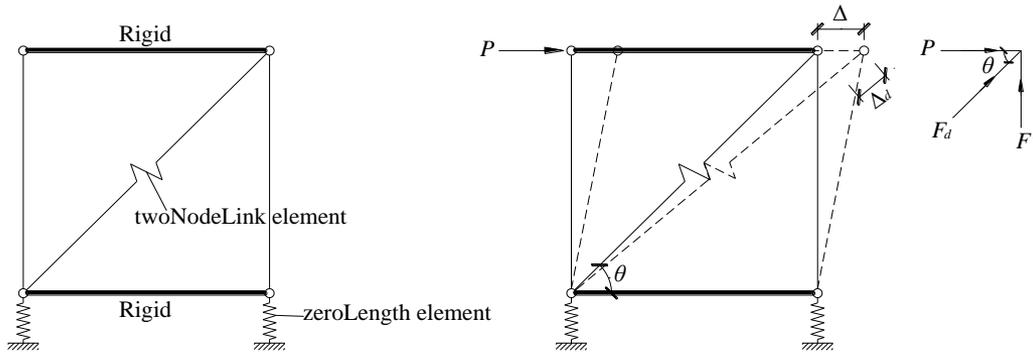
Following aspects we interest:

**Strength**

**Variance**

**Ductility**

# Seismic Performance



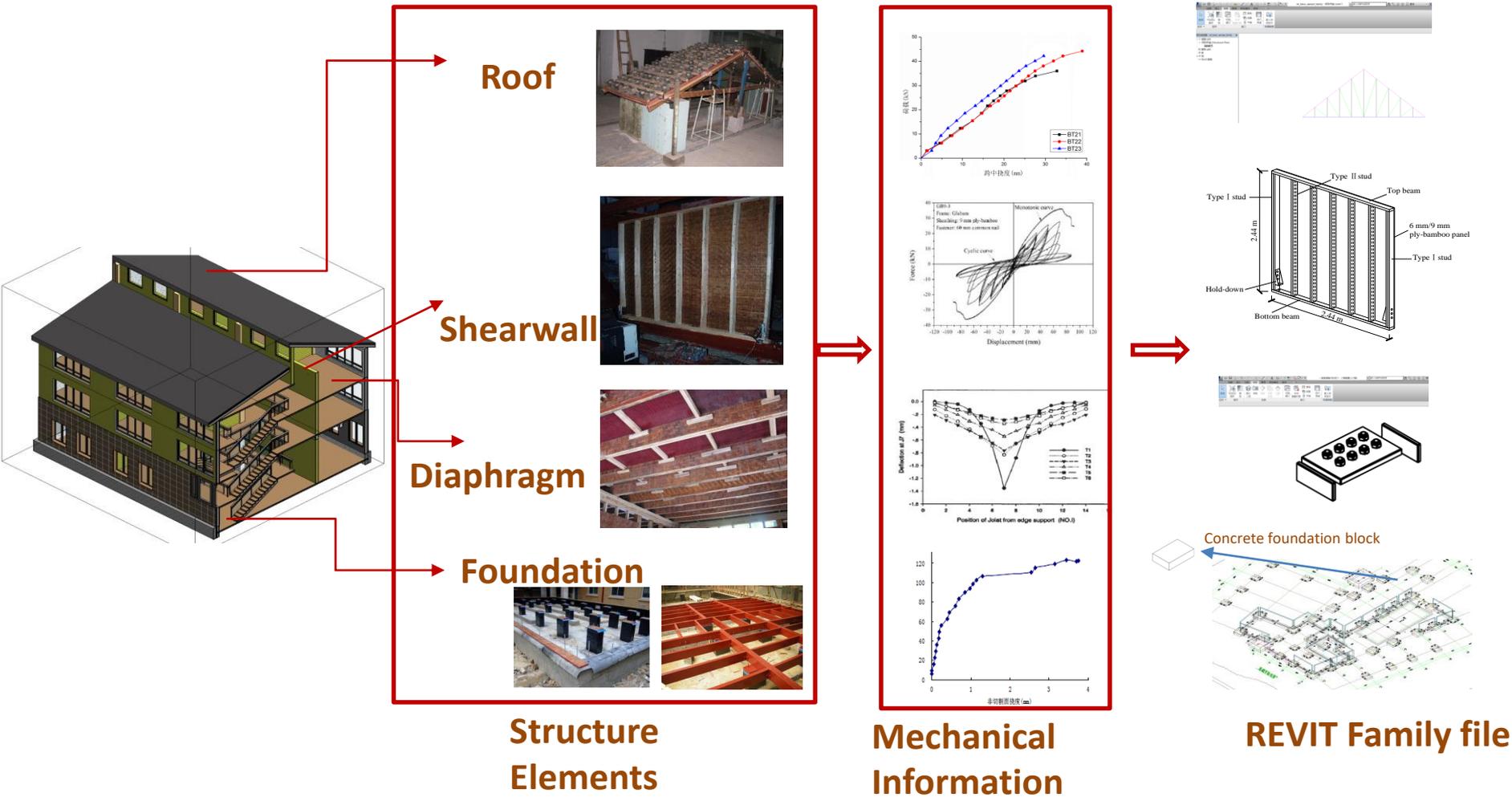
Test for the element

# Table of Content

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1. Research Background
2. Glubam: Structural & Engineered Laminated Bamboo
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# Structure elements of Lightweight bamboo structures and BIM



**Roof**



**Shearwall**



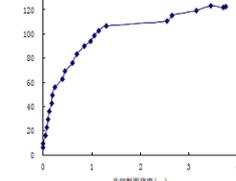
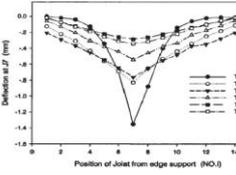
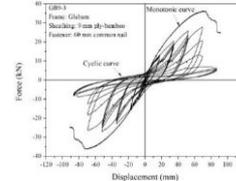
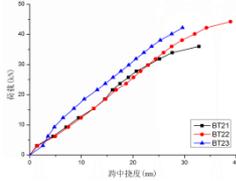
**Diaphragm**



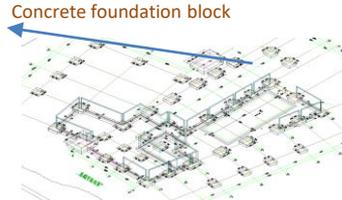
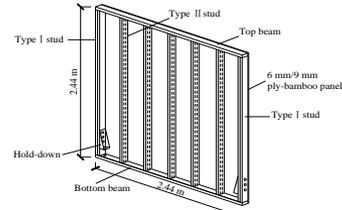
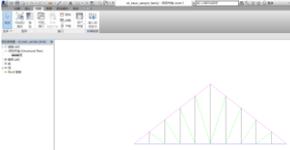
**Foundation**



**Structure Elements**

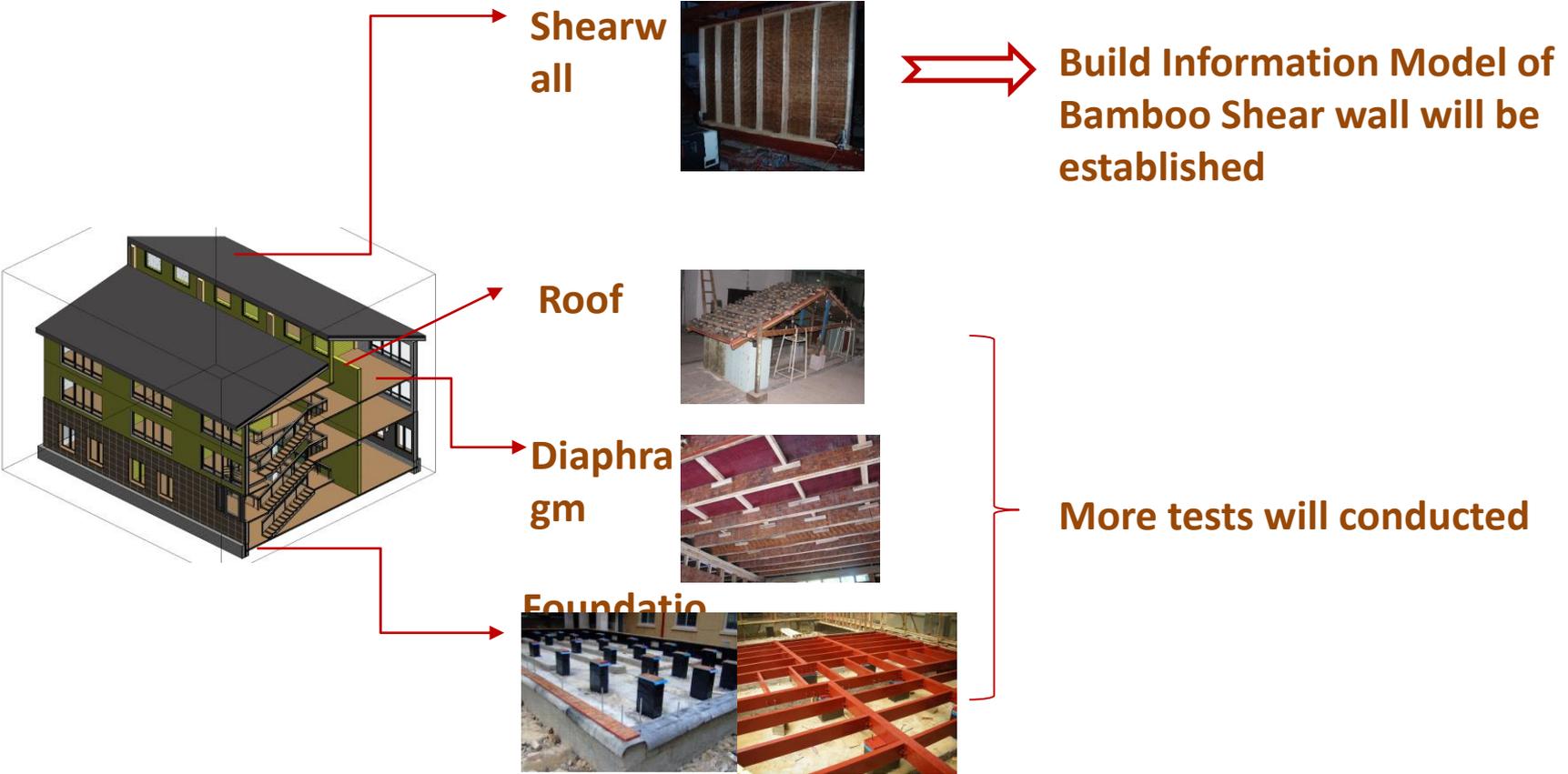


**Mechanical Information**



**REVIT Family file**

## Structure elements of Lightweight bamboo structures/ 轻型竹结构的结构体系

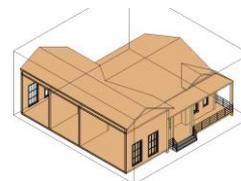
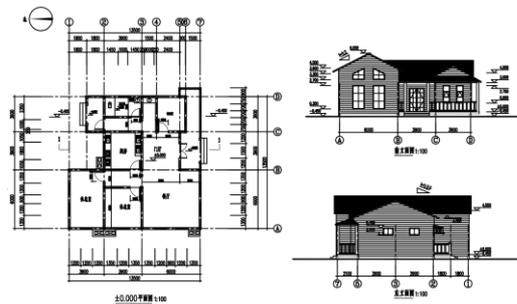


# Table of Content

---

1. Research Background
2. Glubam: Structural & Engineered Laminated Bamboo
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# Case study/ 结构案例

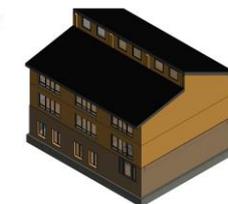
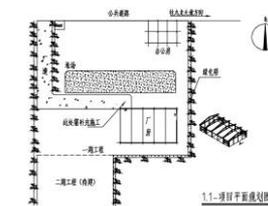


2007

2008

2009

2010-2015



END