Srinakharinwirot University

Civil Engineering

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CAPSTONE/SENIOR DESIGN EXPERIENCE 2025

Title : THE DESIGN OF A FRAME SCAFFOLDING SYSTEM FOR SUPPORTING DEMOLISHED STRUCTURAL COMPONENTS IN DEMOLITION WORKS

Problem Statement

The Siam Pan Pacific Hotel renovation project involves cutting and demolishing the roof slab. A reliable temporary shoring system (frame scaffolding) is urgently needed to support the immense weight of the slab, the concrete cutting machinery, and structural vibrations. Accurate engineering design is crucial to prevent structural failure and ensure operational safety during demolition.

Design Constraints

- Technical Constraints: The shoring system must accommodate dynamic loads and vibrations from the concrete cutting machine. It must also align with the designated floor cutting sequence to avoid uneven concentrated loads.
- Non-technical Constraints: Strict adherence to site safety regulations to protect workers from falling debris, and utilization of available scaffolding inventory (e.g., equipment from Syntec Construction PCL).

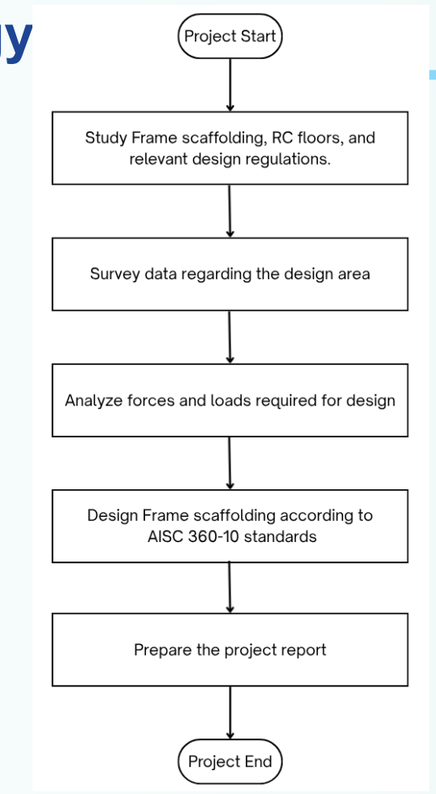
Engineering Standards

- AISC 360-10: structural steel member capacity. EIT 011006-21: scaffolding spacing, bracing and installation.

Design Objectives

- To design a frame scaffolding system that safely supports structural components during demolition based on engineering principles.
- To analyze the load-bearing capacity of the scaffolding under actual dead and live loads, ensuring compliance with structural steel design standards.

Methodology



Design Results

รายการคำนวณโครงสร้างค้ำยันชั่วคราว (Temporary Shoring Calculation Report)

1. Load Calculation				
Description	Quantity	Unit Weight	Unit	Total Weight (kg)
Concrete Cutting Machine Load (incl. Impact Factor 1.5)	2	655	kg	1965.00
Worker Live Load	2	100	kg	200.00
Concrete Slab Weight (1.317 x 2.40 x 0.15 m x 2400 kg/m³)	1	1137.89	kg	1137.89
Miscellaneous	1	75	kg	75.00
Scaffold Tower	1	100	kg	100.00
Total Load			kg	3477.89
Actual Load per Leg (P_actual) = Total Load / 4			kg/leg	869.47

2. Design Criteria				
Actual Load per Leg (P_actual)		875.00	kg	If the actual load is less than the standard value, use 875 kg.
Scaffold Tube Material Properties				
- Yield Strength (Fy)		2400.00	ksc	
- Modulus of Elasticity (E)		2040000.00	ksc	
Scaffold Tube Section Properties (D = 42.7 mm, t = 2.4 mm)				
- Cross-Sectional Area (A)		3.03	cm2	
- Moment of Inertia (I)		6.18	cm4	
- Radius of Gyration (r) = SQRT(I/A)		1.43	cm	

3. (Scaffold Tube Buckling Check				
Unbraced Length (L)		190.00	cm	1.90 m Frame Height
Effective Length Factor (K)		1.00		Pinned-Pinned
Slenderness Ratio (KL/r)		133.04		
Column Slenderness Constant (Cc) = SQRT(2PI()^2E/Fy)		129.47		
Allowable Compressive Stress (Fa) for KL/r > Cc (Euler Equation)		592.90	ksc	
Maximum Allowable Load per Leg (P_allow) = Fa * A		1796.49	kg/ขา	
Scaffold Leg Result Summary (P_actual vs P_allow)		PASS / SAFE		

4. U-Head / Jack Base Extension Check				
Net Core Diameter (D_core)		3.00	cm	
Core Cross-Sectional Area (A_core)		7.07	cm2	
Radius of Gyration (r) = D_core / 4		0.75	cm	
Extended Length (L)		20.00	cm	
Effective Length Factor (Fixed-Free) K		2.00		
Threaded Rod Slenderness Ratio (KL/r)		53.33		
Allowable Compressive Stress (Fa) for KL/r < Cc (Euler Equation)		3689.31	ksc	
Maximum Allowable Load for Threaded Rod (P_allow_thread)		26083.44	kg	
Adjustable Threaded Rod Result Summary		PASS / SAFE		

5. Support Beam Bearing Check				
Total Load (R)		3477.89	kg	
Steel Box Section Thickness (t)		0.32	cm	Steel Box 100x100x3.2 mm
U-Head Bearing Length (N)		10.00	cm	U-Head Base Plate Width
Web Bearing Area (A_bearing) = 2*N*t		6.40	cm2	Calculated for 2 webs of the box section
Actual Bearing Stress (fp) = R / A_bearing		543.42	ksc	
Allowable Bearing Stress (Fp) for SS400 Steel = 0.75Fy		1800.00	ksc	
Steel Box Section Result Summary (fp < Fp)		PASS / SAFE		PASS - No web crippling

BOQ / Cost Estimate

BILL OF QUANTITIES

Project: Frame scaffolding supporting demolished structural components (Siam Pan Pacific Hotel)

No.	Description	Qty	Unit	Material (THB/unit)	Labour (THB/unit)	Amount (THB)
1. Scaffolding and temporary shoring						
1.1	Frame scaffolding 1.219 × 1.829 × 1.70 m with cross braces and joints (rent per set per month)	120.00	sets	250.00	45.00	35,400.00
1.2	U-head jack Ø30 mm, L = 60 cm, solid thread (rent)	240.00	pcs	40.00	10.00	12,000.00
1.3	Base jack Ø30 mm, L = 60 cm, solid thread (rent)	240.00	pcs	35.00	10.00	10,800.00
1.4	Square tube 100 × 100 × 3.2 mm (TIS 107), 6.0 m long	30.00	pcs	1,580.00	120.00	51,000.00
1.5	Timber sole plates to spread load onto the slab	60.00	pcs	180.00	25.00	12,300.00
2. Concrete cutting equipment						
2.1	Concrete floor cutter (655 kg) rental, full set	1.00	month	35,000.00	5,000.00	40,000.00
2.2	Diamond saw blade 24–30 in	4.00	pcs	4,800.00	0.00	19,200.00
2.3	Power supply and blade water / dust suppression	1.00	job	3,500.00	2,500.00	6,000.00
3. Labour and safety						
3.1	Labour: erect and dismantle scaffold towers	120.00	sets	0.00	120.00	14,400.00
3.2	Technician: floor cutting and breaking	1.00	job	0.00	28,000.00	28,000.00
3.3	PPE and dust / falling-debris protection	1.00	job	8,500.00	3,500.00	12,000.00
				Direct cost (materials + labour)		241,100.00
				Overhead, profit and VAT	25%	60,275.00
				GRAND TOTAL		**301,375.00**

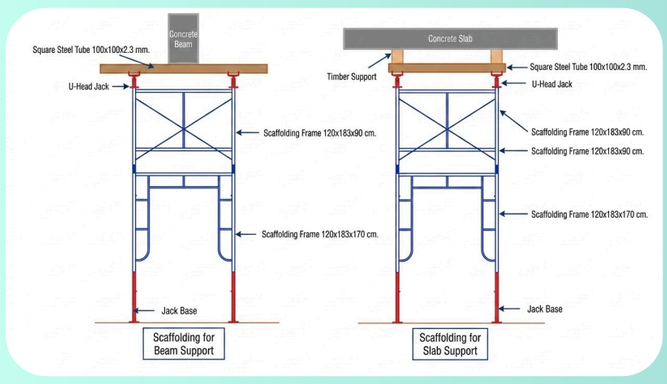
Conclusion and Recommendations

Conclusion:

Each leg carries 869.47 kg against an allowable 1,796.49 kg (about 2.07 times), and the U-heads and supports are within limits, so the shoring is safe for demolition.

Recommendations:

- Inspect scaffolding condition thoroughly before use (remove any distorted or rusted parts).
- Verify supporting base stability (ensure the use of sole plates to distribute forces).
- Strictly follow the designated floor cutting sequence to avoid dangerous concentrated loads.





Key courses used in the project

- **Structural Analysis:** Used for determining reactions and internal force distribution within the scaffolding frames.
- **Structural Steel Design:** Applied for member capacity verification based on AISC 360-10 standards.
- **Construction Engineering and Management:** Used for planning the demolition sequence, site logistics, and equipment handling.
- **Construction Safety Management:** Applied for risk assessment and establishing safety protocols for temporary structures.
- **Mechanics of Materials:** Used for calculating stress and strain on the hollow steel sections and adjustable U-heads.

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