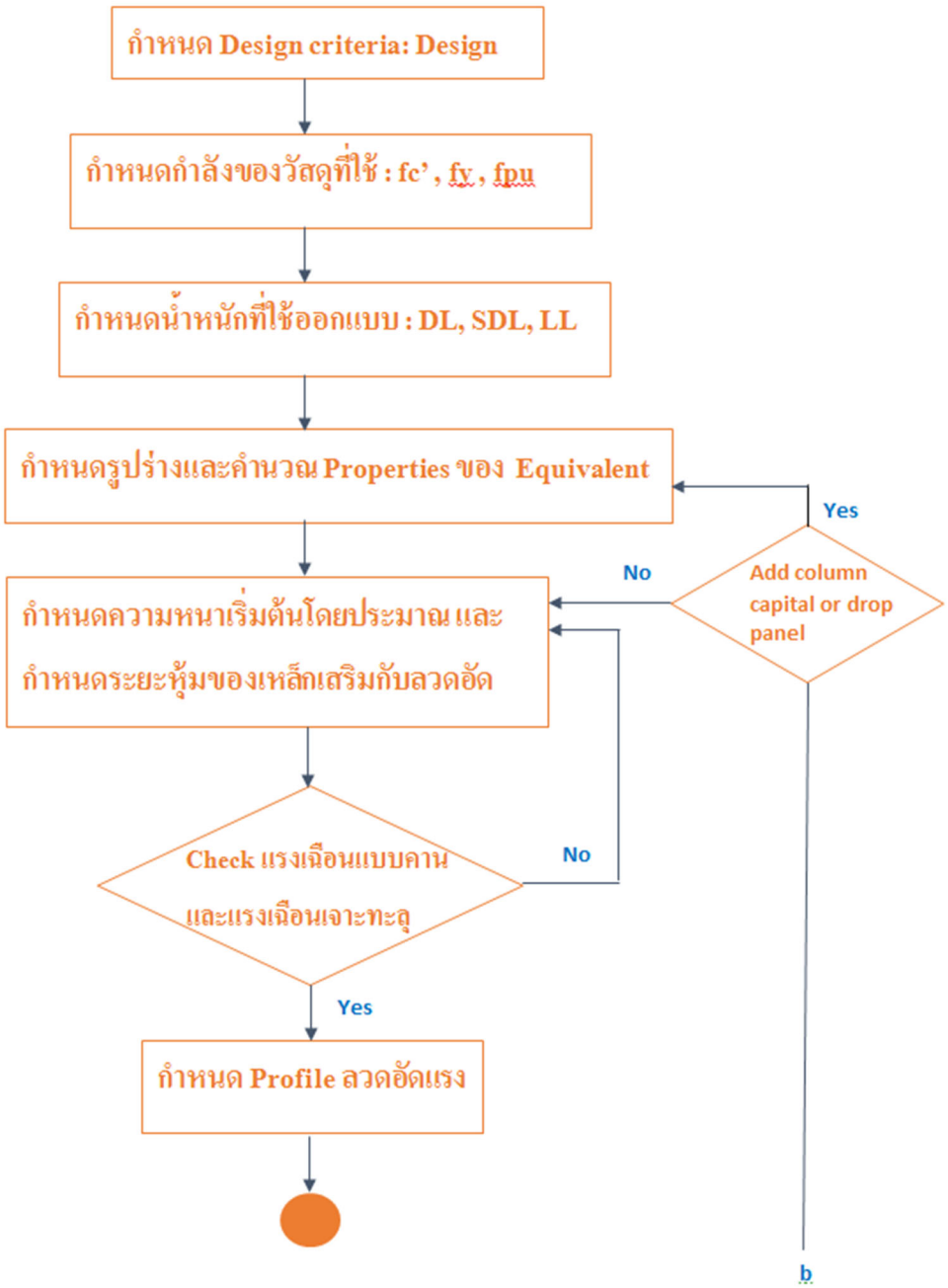
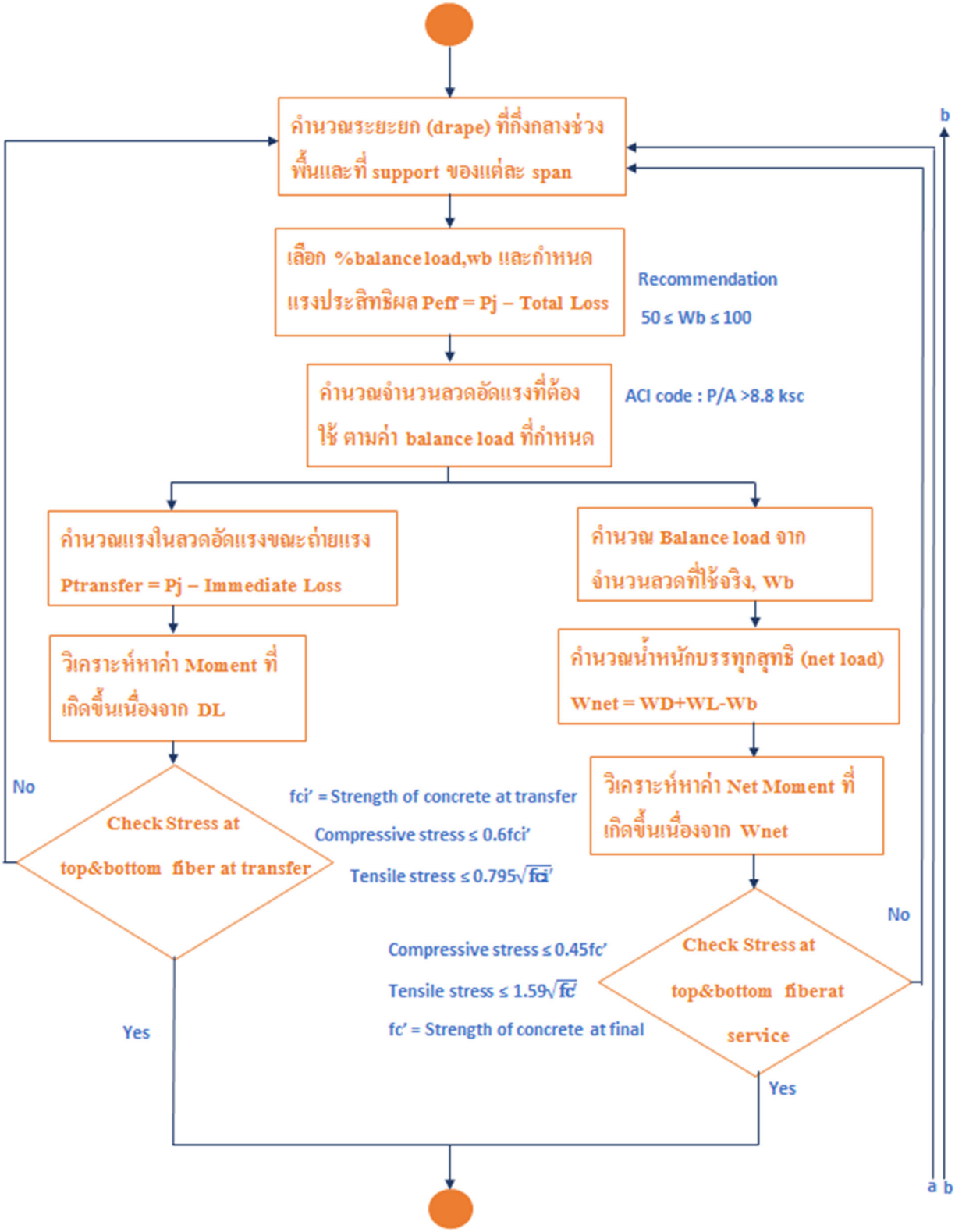
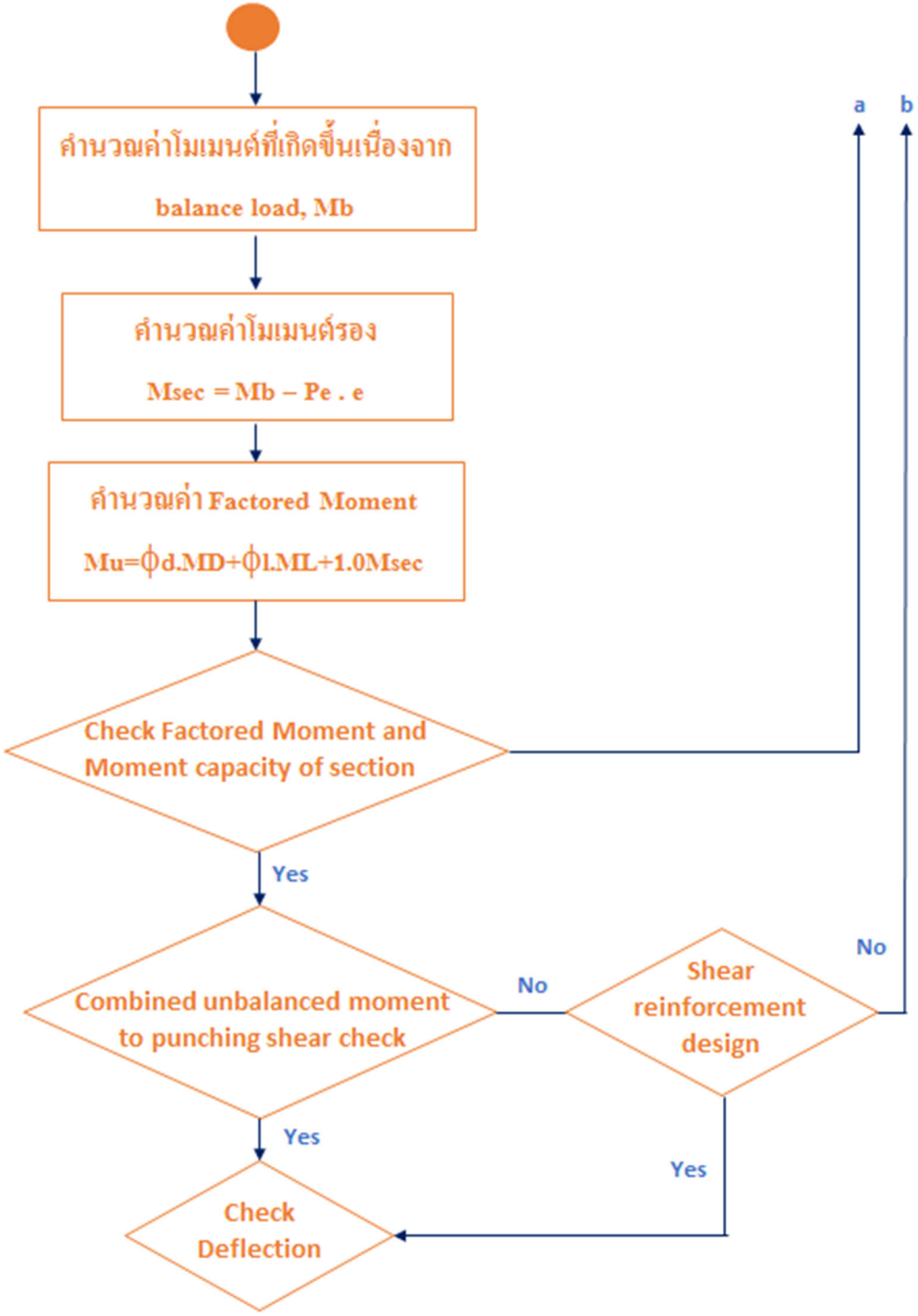
Post-Tension Design Using Manual Calculation and Computer Program

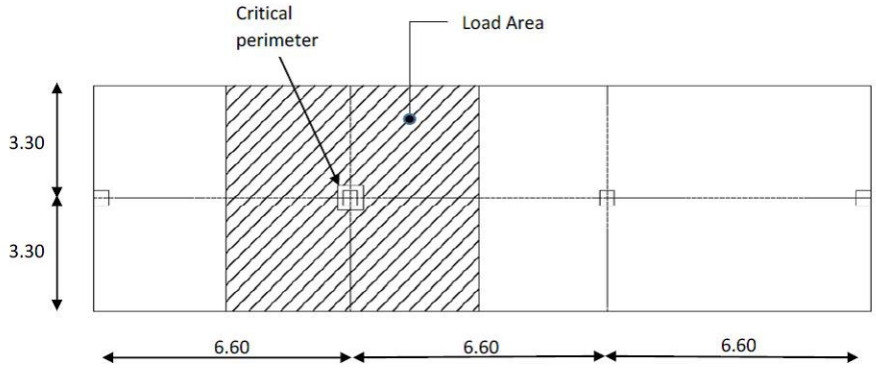
Analysis and design of post tension floor using equivalent frame method is a today's popular method since it is easy and fast. It can easily be developed into a spreadsheet or calculation program. Rough sequence is as follows:

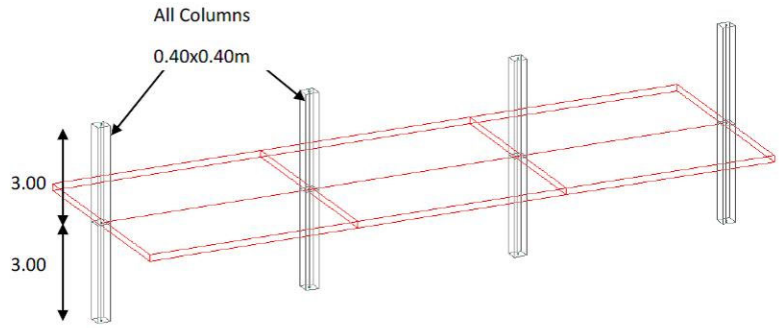



คำนวณระยะยก (drape) ที่กึ่งกลางช่วง พื้นและที่ support ของแต่ละ span
เลือก %balance load,wb และกำหนด แรงประสิทธิผล Peff = Pj – Total Loss
Recommendation
50 ≤ Wb ≤ 100
คำนวณจำนวนลวดอัดแรงที่ต้องใช้ ตามค่า balance load ที่กำหนด
ACI code : P/A >8.8 ksc
คำนวณแรงในลวดอัดแรงขณะถ่ายแรง Ptransfer = Pj – Immediate Loss
คำนวณ Balance load จากจำนวนลวดที่ใช้จริง, Wb
วิเคราะห์หาค่า Moment ที่เกิดขึ้นเนื่องจาก DL
คำนวณน้ำหนักบรรทุกสุทธิ (net load) Wnet = WD+WL-Wb
วิเคราะห์หาค่า Net Moment ที่เกิดขึ้นเนื่องจาก Wnet
No
Check Stress at top&bottom fiber at transfer
fci' = Strength of concrete at transfer
Compressive stress ≤ 0.6fci'
Tensile stress ≤ 0.795√fci'
Yes
Compressive stress ≤ 0.45fc'
Tensile stress ≤ 1.59√fc'
fc' = Strength of concrete at final
Check Stress at top&bottom fiberat service
No
Yes
b
a b



The sequence above can be used to design post tension floor with structural characteristics following the image below. The calculation is done manually and the results are compared with design done by computer programs, one is called DON_POST as well as other international programs.





Material	Concrete	fc' slab	320	ksc
		fc' Column	240	ksc
	Rebar SD40	fy	4000	ksc
	Strand diameter 12.7mm Low relaxation			
		fpu	18,975	ksc
Design code	ACI318-99	ϕD = 1.4, ϕL = 1.7		
Load	SDL	200	kg/m^2	
	LL	200	kg/m^2	

All three methods use the same amount of strands which is span 1 and 2 containing 16 strands and span 3 containing 11 strands, Strand profile is aligned to ensure that stresses at top and bottom fiber meet standard requirements and maintain a balance load within recommended range.

Table shows the calculation of incremental moment

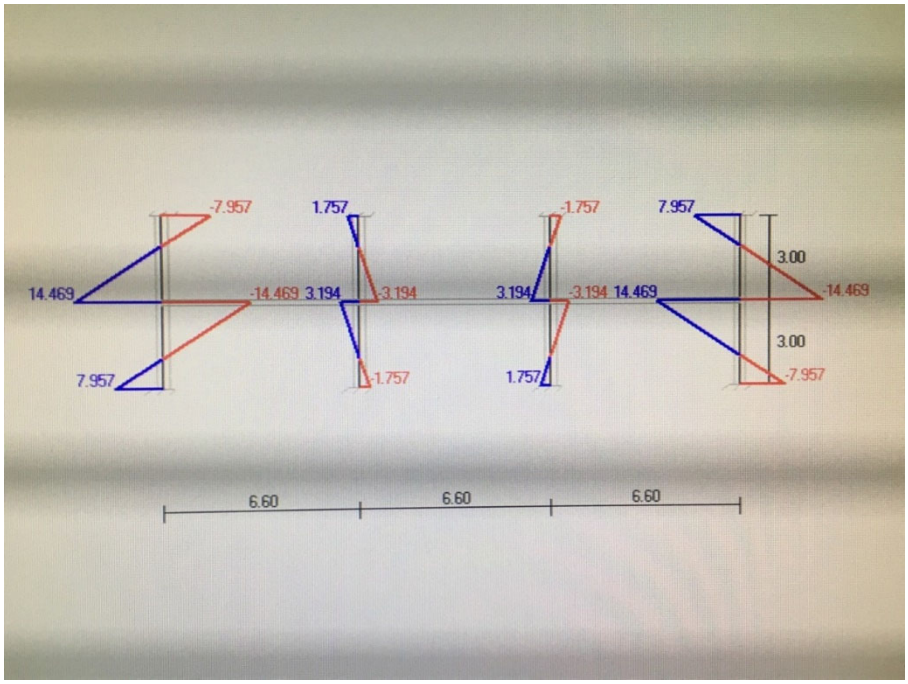
Calculation method	Positive Moment at SPAN 1	Positive Moment at SPAN 2	Negative moment of inner column
Manual calculation	27083	21125	23140
DON_POST	14010	12044	12590
ADAPT PT2012	-36378	-37581	-35020

Based on the result of structural analysis to identify occurred moment force in different positions of the structure, it showed that the results of each method of calculation yielded similar figure. The slight difference may probably be due to different assumptions used to analyze the structure as well as the calculation scale.

Once a designer understand the design sequence of post-tension floor, incorporating computer program to help with the design can speed up the process as the results can be viewed, inspected, and amended until the design passes the criteria. The process follows the steps in the flow chart.

Note:

DON_POST is a design program made for beamless steel reinforced concrete and prestressed concrete floors developed by a Thai developer. This is a great starting point for design industry of post-tension floor as the calculated results can similarly be compared to international programs. In addition, the program also displays crucial data to building designers e.g. graphical result of moment transfer to columns which allows building designers to determine whether moment affects the columns. Further development of DON_POST program is therefore interesting which would make it even more responsive to post-tension floor design and in the future it may be fully developed with equivalent functionality to commercial programs.



เรียบเรียงโดย

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เอกสารอ้างอิง

1.“Specialist Guide: Design of Post-Tension System”, TUMCIVIL

2.Design Program for Post-Tension Floor and Beamless Steel Reinforced Concrete Floor "DON_POST", Dr. Sorakarn Sri Tong Orn