THE REINFORCED CONCRETE PROJECT

INTRODUCTION

The name of subject: The reinforced concrete project

Code: CSU-CIE-377

Credit: 1

Lecturer: Phạm Phú Anh Huy

The built technology division-The faculty of engineering

Textbooks

[1] Bộ môn Công trình bê tông cốt thép-Đại học Xây dựng, Sàn sườn bê tông cốt thép toàn khối, NXB Xây dựng 2012

[2] Phạm Phú Anh Huy, Tập bài giảng Đồ án Kết cấu bê tông cốt thép, Đại học Duy Tân, 2014

INTRODUCITION

[1] Bộ môn Công trình bê tông cốt thép-Đại học Xây dựng, Sàn sườn bê tông cốt thép toàn khối, NXB Xây dựng 2012

[2] Phạm Phú Anh Huy, Tập bài giảng Đồ án Kết cấu bê tông cốt thép, Đại học Duy Tân, 2014

[3] Bộ Xây dựng-Công Ty Tư Vấn Xây Dựng Dân Dụng Việt Nam, Cấu Tạo Bê Tông Cốt Thép, NXB Xây Dựng, Hà Nội 2004

[4] Nguyễn Đình Cống, Tính toán thực hành cấu kiện bê tông cốt thép theo tiêu chuẩn TCXDVN356-2005, Nhà xuất bản Xây Dựng, Hà Nội 2007

INTRODUCTION

GRADING:

- Attendance/participation 15%
- Usual checking 30%
- Final Exam 55%

THE REINFORCED CONCRETE PROJECT

THE SYLLABUS

Binding

The engagement

Chapter 1: The mission of project

1.1. The beginning data

1.2. The material

1.3. The slab classification

1.4. Choose preliminarily the dimensions of components

THE REINFORCED CONCRETE PROJECT

THE SYLLABUS

Chapter 2: Design the slab
2.1. The calculation method
2.2. The calculation modeling
2.3. Choose preliminarily the dimensions of slab
2.4. The calculation span (clear span)
2.5. The loads
2.6. The internal force
2.7. Calculate the reinforcement area
2.8. Choose the temperature and shrinkage steel
2.9. Draw the drawing
2.10. Summarize the material

THE REINFORCED CONCRETE PROJECT

THE SYLLABUS

Chapter 3:Design the beam(or the beam along l_2 direction)

3.1. The calculation method

3.2. The calculation modeling

3.3. Choose preliminarily the dimensions of section

3.4. Calculate the calculation span (clear span)

3.5. Calculate the loads

3.6. Calculate the internal force(the envelope internal force diagram)

3.7. Calculate the reinforcement area

3.8. Choose the temperature and shrinkage steel

3.9. Calculate and draw the envelope material diagram

3.10. Draw the drawing

3.11. Summarize the material

THE REINFORCED CONCRETE PROJECT

THE SYLLABUS

Chapter 4:Design the girder(or the beam along l_1 direction)

4.1. The calculation method

4.2. The calculation modeling

4.3. Choose preliminarily the dimensions of section

4.4. Calculate the calculation span

4.5. Calculate the loads

4.6. Calculate the internal force(the envelope internal force diagram)

4.7. Calculate the reinforcement area

4.8. Choose the temperature and shrinkage steel

4.9. Calculate and draw the envelope material diagram

4.10. Draw the drawing

4.11. Summarize the material

THE REINFORCED CONCRETE PROJECT

THE SYLLABUS

Chapter 5: The drawing

5.1. Summarize the data

5.2. Draw the drawing

Conferences

CHAPTER 1: THE DATA OF PROJECT

1.1. THE DATA

–The students will have a data table with the information such as:

- ✓L_1: short side dimension of slab
- ✓L_2: long side dimension of slab
- ✓The structure plan view
- ✓$P_{tc}(kN/m^2)$: the standard live load

CHAPTER 1: THE DATA OF PROJECT

1.2. THE MATERIAL

– Grade of concrete

–Grade of steel.

–Look up the data: R_b, R_{bt}, E_b

R_s, R_{sc}, R_{sw}, E_s

ξ_R, α_R, ξ_{pl}, α_{pl}

CHAPTER 1: THE DATA OF PROJECT

1.3. CLASSIFICATION

- The slabs have four side with connection
  - ✓$L_2/L_1 \geq 2$ → neglect the slab working according to the long side, and we see the slab work according to short side → The one-way slab
  - ✓$L_2/L_1 < 2$ → not neglect the slab working according to the long side, and we see the slab work according to two side → The two-way slab

CHAPTER 1: THE DATA OF PROJECT

1.4. CHOOSE PRELIMINARILY THE DIMENSION OF COMPONENTS

❖Slab:

$$h_b = \frac{D}{m}.l$$

❖Beam:

$$h_{dp} = (\frac{1}{12} \div \frac{1}{16}).l$$

❖Girder:

$$h_{dc} = (\frac{1}{8} \div \frac{1}{12}).l_{dc}$$

From h_{dp} and h_{dc} we choose b_{dp} and b_{dc}

❖Column: choose $b_c = b_{dc}$

❖Wall: choose the wall thickness b_t=340mm

CHAPTER 2: THE SLAB DESIGN

2.1. THE CALCULATION METHOD

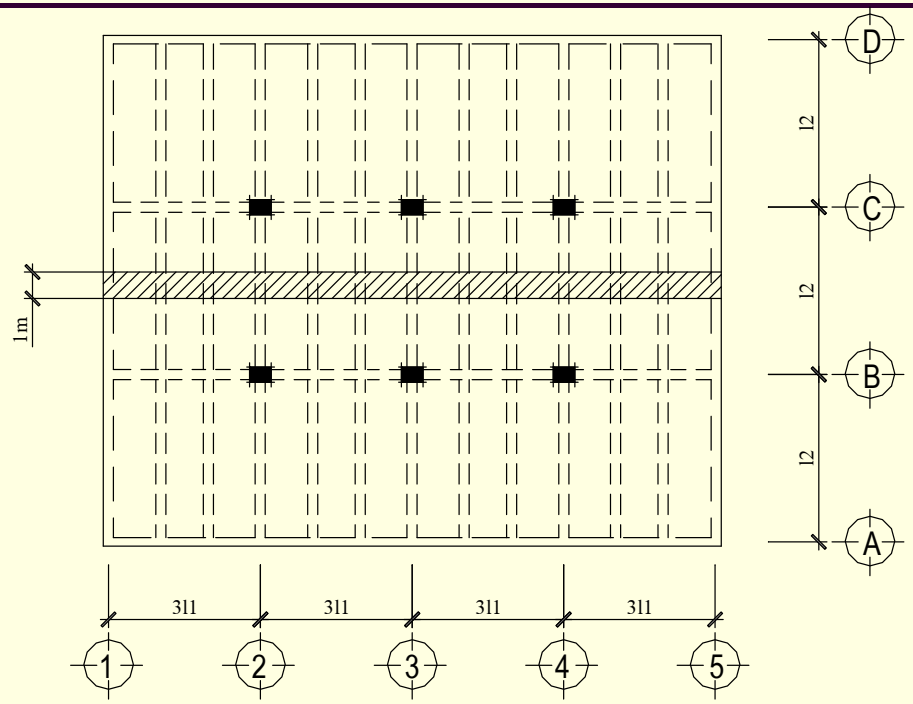
-Can use among of two method to calculate the internal force

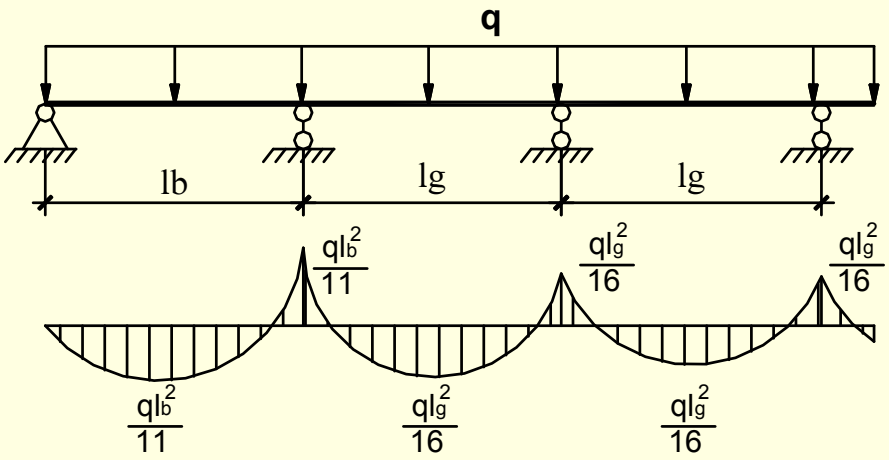
- ✓The elastic method
- ✓The plastic method

- The slab is required to calculate the plastic method

CHAPTER 2: THE SLAB DESIGN

2.2. THE CALCULATION MODEL





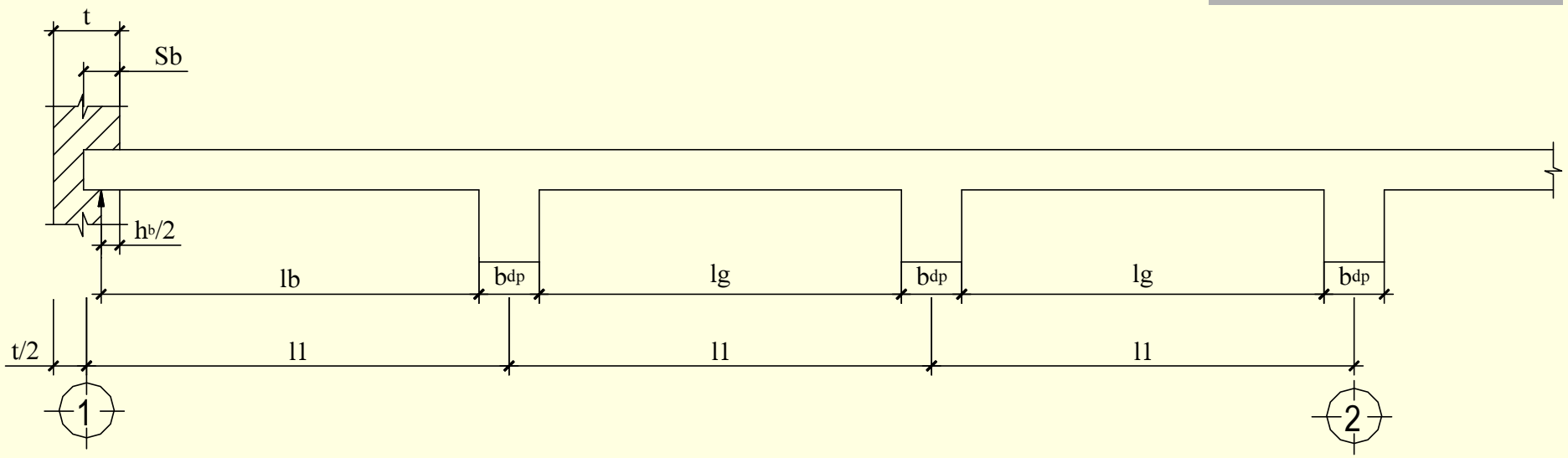
CHAPTER 2: THE SLAB DESIGN

2.3. CHOOSE PRELIMINARILY THE THICKNESS OF SLAB

- h_b is chosen in chapter 1

CHAPTER 2: THE SLAB DESIGN

2.4. THE CALCULATION SPAN



- $l_b = l_1 – t/2 – b_{dp}/2 + h_b/2.$
- $l_g = l_1 - b_{dp}$

CHAPTER 2: THE SLAB DESIGN

2.5. THE LOADS

- Dead load: depends on the detail of slab

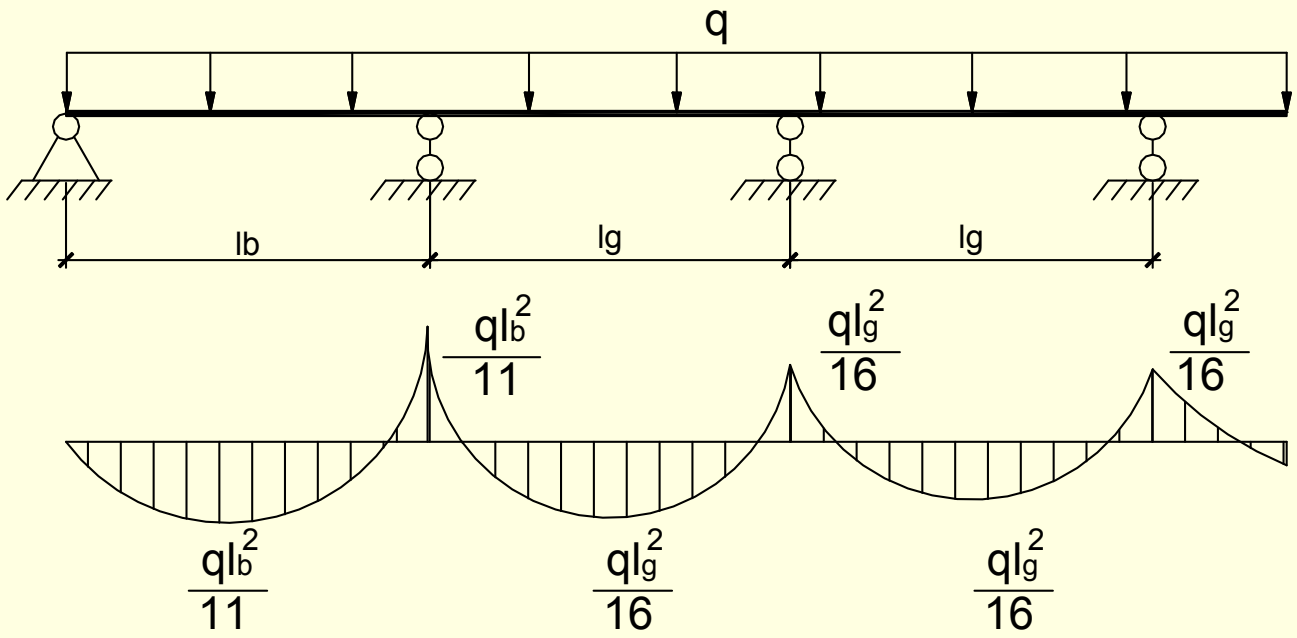
Details	The standard value (kN/m^3)	Safety parameter	The calculation value (kN/m^2)
Floor brick layer, thickness 10mm; γ = 20 kN/m^3	0,01 x 20 = 0,2	1,1	0,22
Cement mortar layer, thickness 30mm; γ = 18 kN/m^3	0,03 x 18 = 0,54	1,3	0,702
Slab, thichness 80mm γ = 25 kN/m^3	0,08 x 25 = 2	1,1	2,2
Cement mortar layer, thickness 10mm; γ = 18 kN/m^3	0,01 x 18 = 0,18	1,3	0,234
Total	2,92		3,356

- Live load: according to Vietnam code(TCVN2737-1995)

CHAPTER 2: THE SLAB DESIGN

2.6. THE INTERNAL FORCE

- Calculate the internal force according to the plastic model



CHAPTER 2: THE SLAB DESIGN

2.7. CALCULATE THE REINRFORCEMENT AREA

-To calculate the reinforcement area of slab, we can use only the tension einforcement procedure of the rectangular section.

-The calculation section is the rectangular with the dimensions ($1m x h_b$)

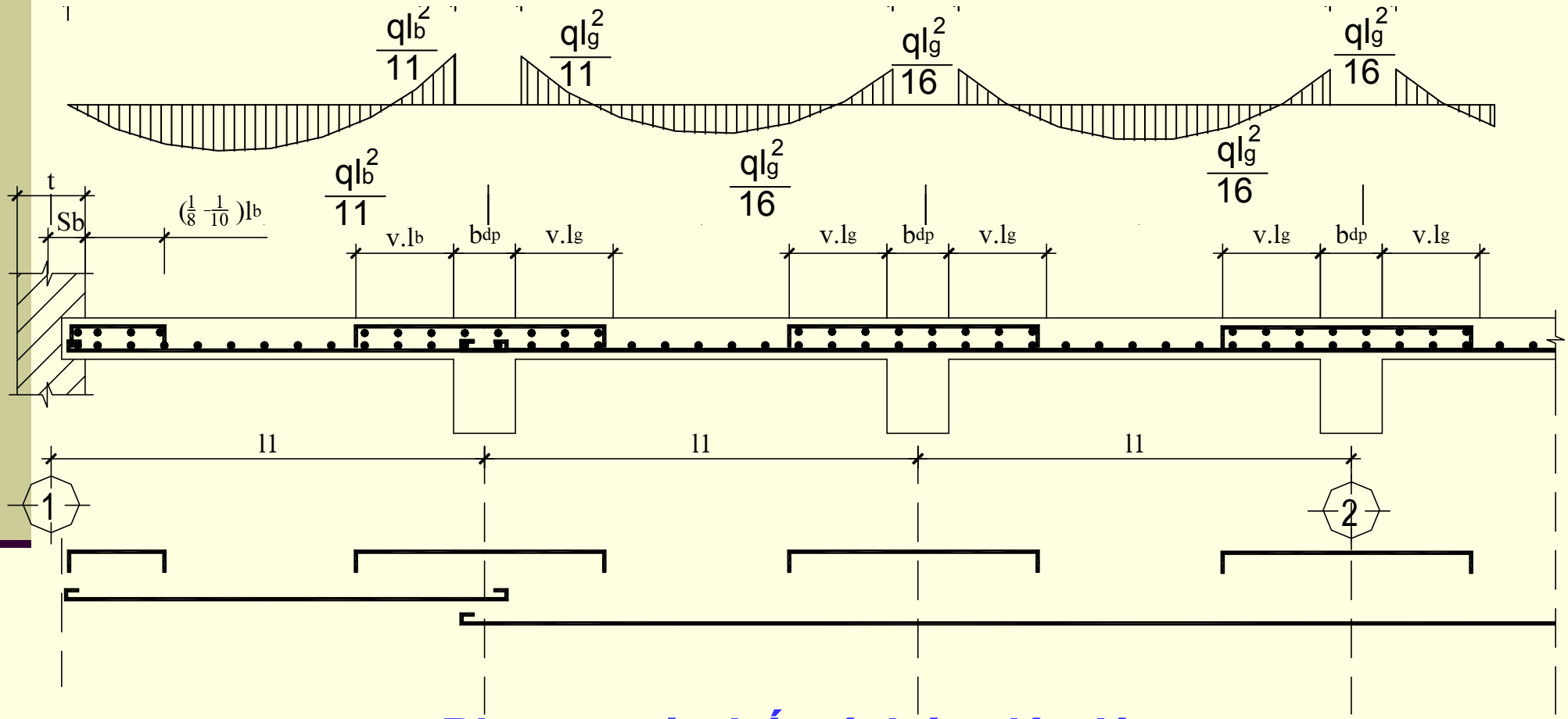
CHAPTER 2: THE SLAB DESIGN

2.8. CHOOSE THE TEMPERATURE AND SHINKAGE STEEL

- The temperature and shinkage steel area: $A_{s,t} \geq (15\text{-}20)\%\ A_s$
- The top of shinkage steel: $A_{s,ts} \geq 50\%\ A_s$ and the spacing ≤ 200mm

CHAPTER 2: THE SLAB DESIGN

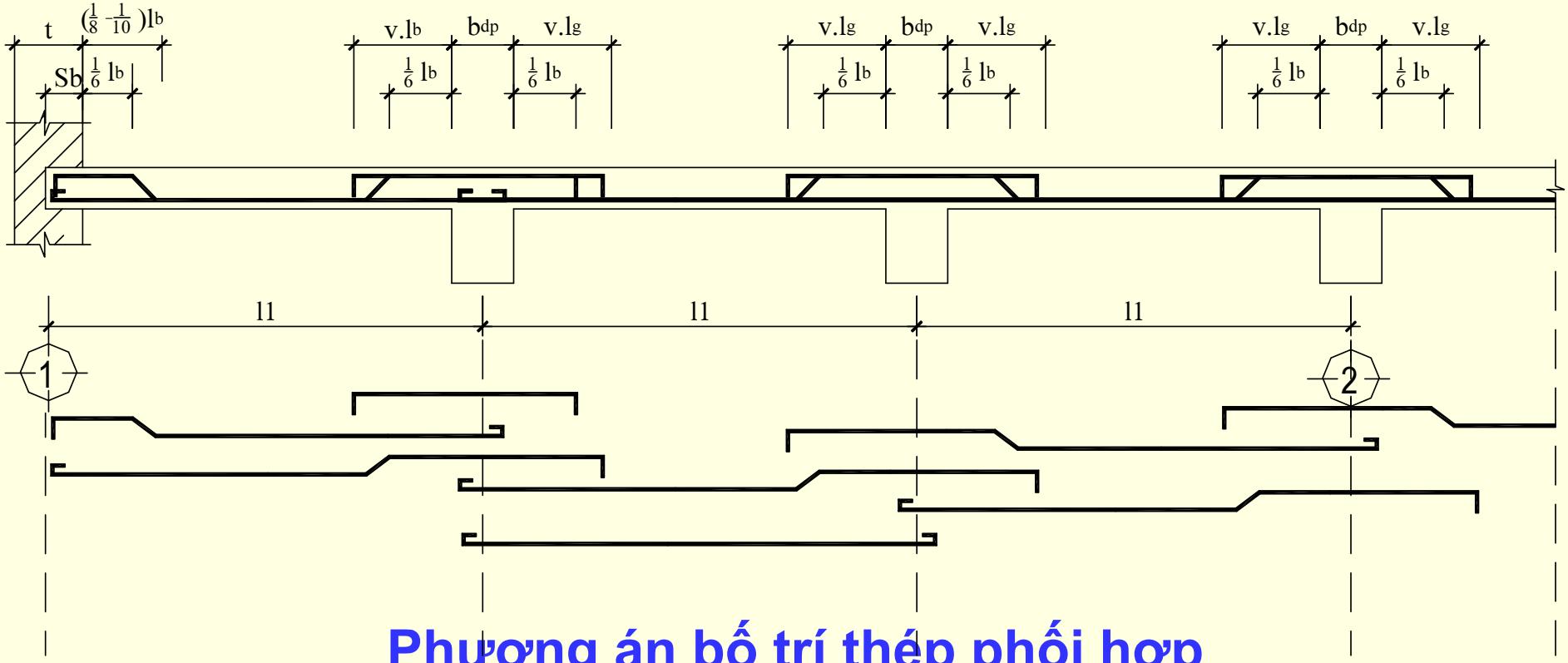
2.9. THE DRAWING



Phương án bố trí thép độc lập

CHAPTER 2: THE SLAB DESIGN

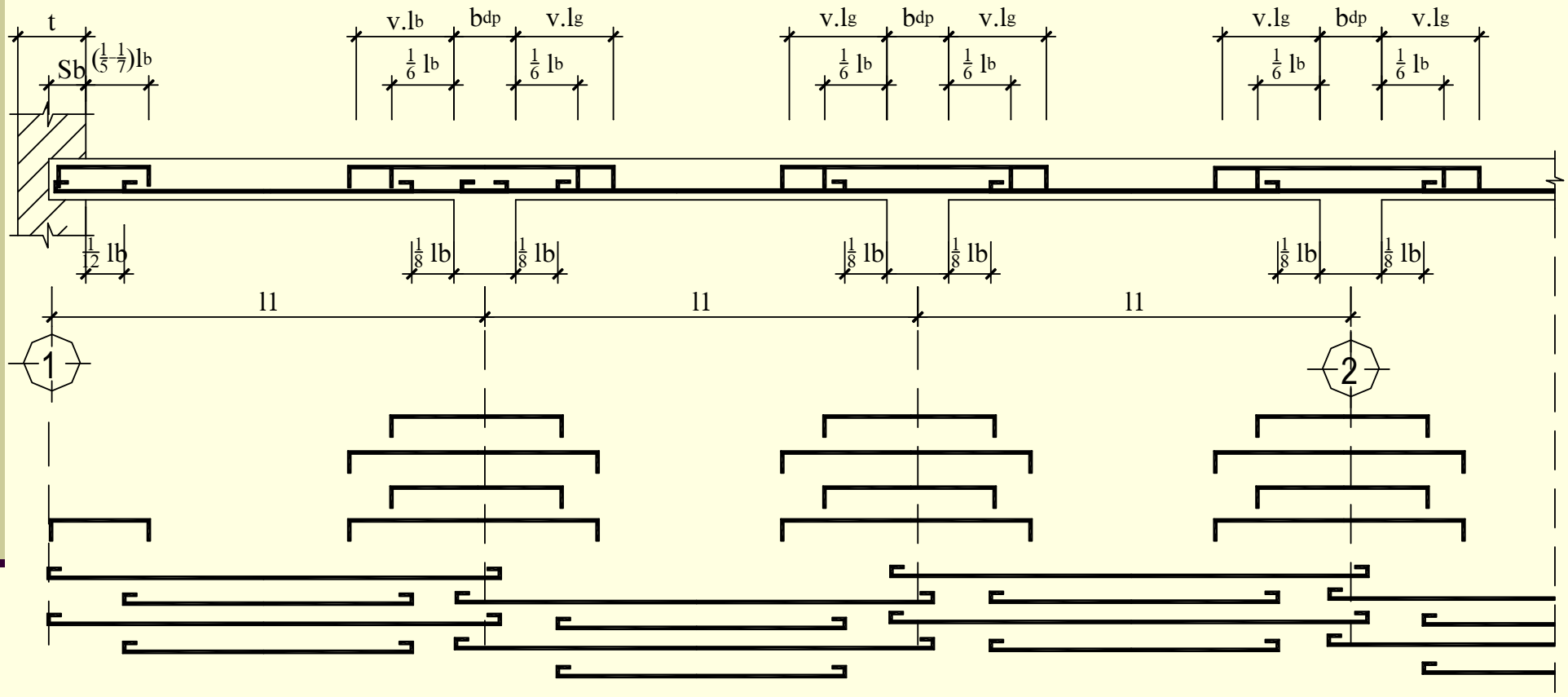
2.9. THE DRAWING



Phương án bố trí thép phối hợp

CHAPTER 2: THE SLAB DESIGN

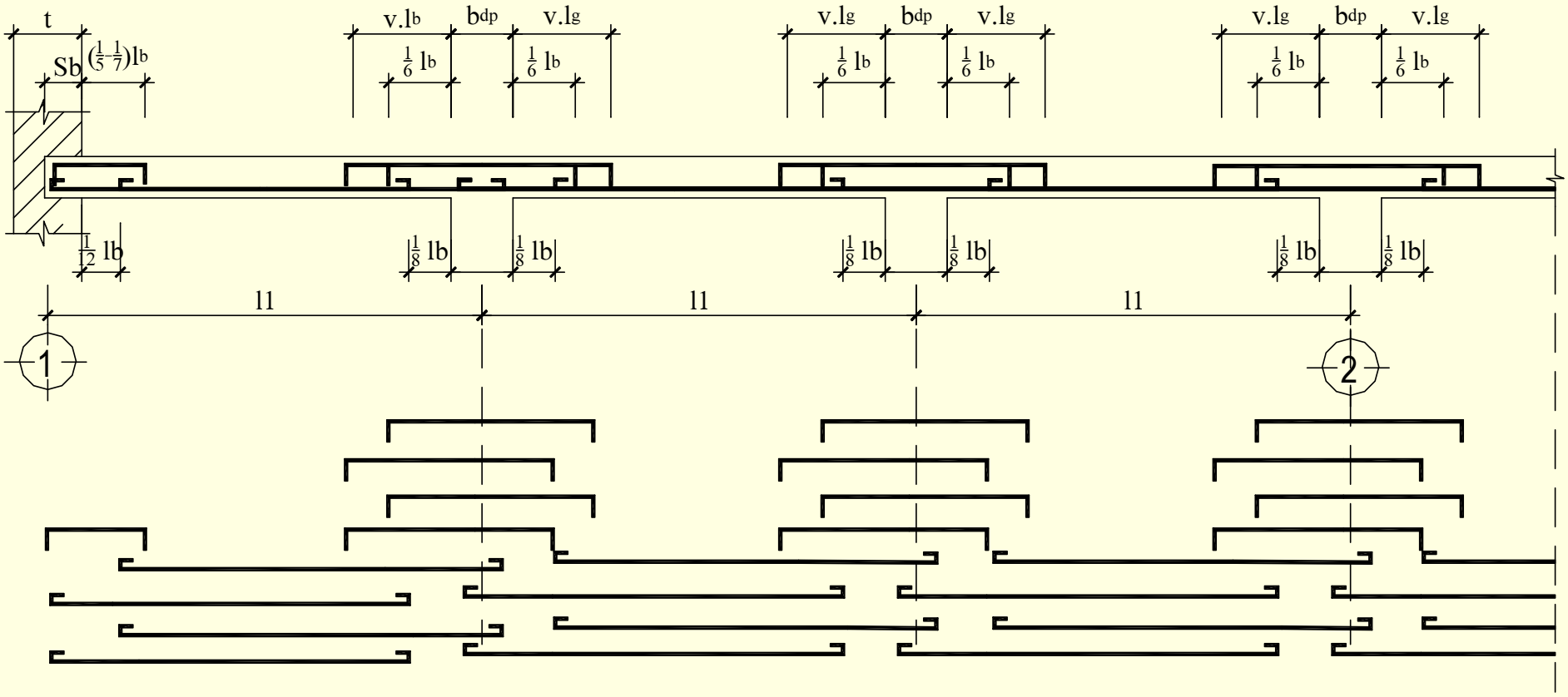
2.9. THE DRAWING



Phương án bố trí thép: thanh dài, ngắn xen kẽ

CHAPTER 2: THE SLAB DESIGN

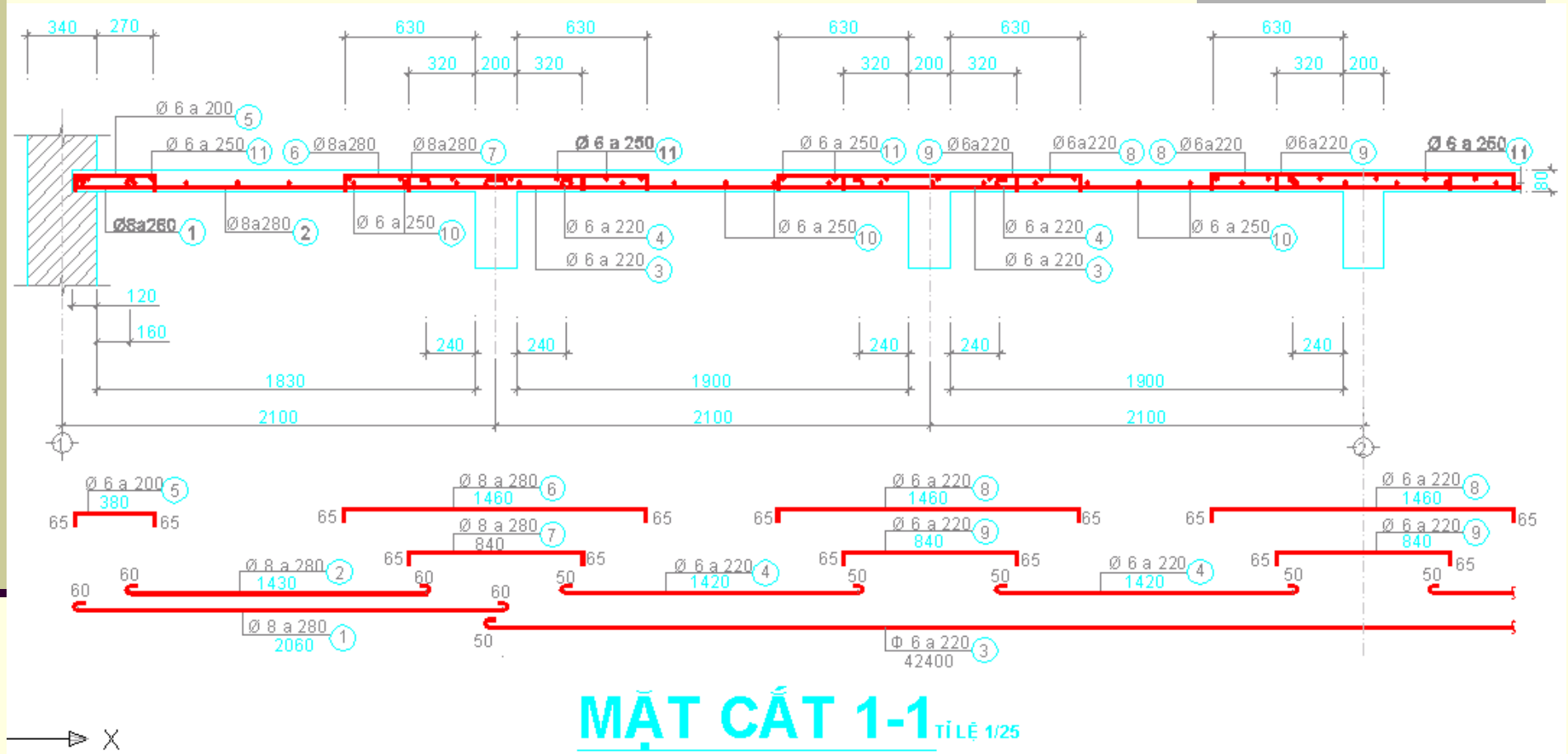
2.9. THE DRAWING



Phương án bố trí thép: thanh ngắn đặt so le

CHAPTER 2: THE SLAB DESIGN

2.9. THE DRAWING



CHAPTER 2: THE SLAB DESIGN

2.10. SUMARIZE THE MATERIAL

BẢNG THỐNG KÊ CỐT THÉP

Tên cấu kiện	Số hiệu thanh	Hình dáng	Đường kính (mm)	Số lượng thanh	Chiều dài 1 thanh (mm)	Chiều dài Tổng cộng (m)	Trọng lượng (kg)
BẢN SÀN (SL:1)	1	60 — 2060 — 60	8	193	2175	419,78	165,810
	2	60 — 1430 — 60	8	193	1550	299,15	118,164
	3	50 — 42400 — 50	6	112	42500	4760	1056,72
	4	50 — 1420 — 50	6	1070	1520	1626,4	361,061
	5	65 — 380 — 65	6	522	510	266,22	59,100
	6	65 — 1460 — 65	8	193	1590	306,87	121,214
	7	65 — 840 — 65	8	193	970	187,21	73,948
	8	65 — 1460 — 65	6	963	1590	1531,17	339,920
	9	65 — 840 — 65	6	963	970	934,11	207,372
	10	50 — 26820 — 50	6	101	26920	2178,92	603,600
	11	50 — 26820 — 50	6	68	26920	1830,56	406,384
	12	65 — 1200 — 65	6	504	1330	670,32	148,811
	13	50 — 25020 — 50	6	24	25120	602,88	133,839

BẢNG TỔNG HỢP VẬT LIỆU

NHÓM CỐT THÉP	CI		CII							
ĐƯỜNG KÍNH (mm)	6	8	12	14	16	18	20	22	25	28
TRỌNG LƯỢNG (Kg)	3055,2	1027	0	0	0	0	0	0	0	0

CHAPTER 2: THE SLAB DESIGN

DESIGN THE SLAB ACCORDING TO THE PLASTIC MODEL – TWO-WAY SLAB

The method and design is the same of the one-way slab. In here, there is different at the calculation internal force step.

The two-way slab work two directions, when the slab has 4 sides with fix connection, we have 4 the moment vales

Bảng 5.1: Tỷ số mômen trong bản kê bốn cạnh khi tính theo sơ đồ khớp dẻo

$r = \frac{l_2}{l_1}$	$\frac{M_2}{M_1}$	$\frac{M_I}{M_1}, \frac{M_I'}{M_1}$	$\frac{M_{II}}{M_1}, \frac{M_{II}'}{M_1}$
1÷1,5	1÷0,3	2,5÷1,5	2,5÷0,8
1,5÷2	0,5÷0,15	2÷1	1,3÷0,3

CHAPTER 3: THE BEAM DESIGN

3.1.THE DESIGN METHOD

-Can use among of two method to calculate the internal force

- ✓The elastic method
- ✓The plastic method

- The beam is required to design the plastic method

CHAPTER 3: THE BEAM DESIGN

3.2. THE CALCULATION MODEL

- The calculation model of beam is the continuos beam with 3 or 4 or 5 spans

CHAPTER 3: THE BEAM DESIGN

3.3. CHOOSE PRELIMINARILY THE DIMENSIONS OF BEAM SECTION

- We chosen it in chapter 1

CHAPTER 3: THE BEAM DESIGN

3.4. THE CALCULATION SPAN

- The egde span: is chosen the spacing from the reaction of wall to the edge of girder
- The internal spans: is chosen the spacing between the inside edge of girder

$$l_b = l_2 - \frac{b_{dc}}{2} - \frac{b_t}{2} + \frac{S_d}{2}$$

$$l_g = l_2 - d_{dc}$$

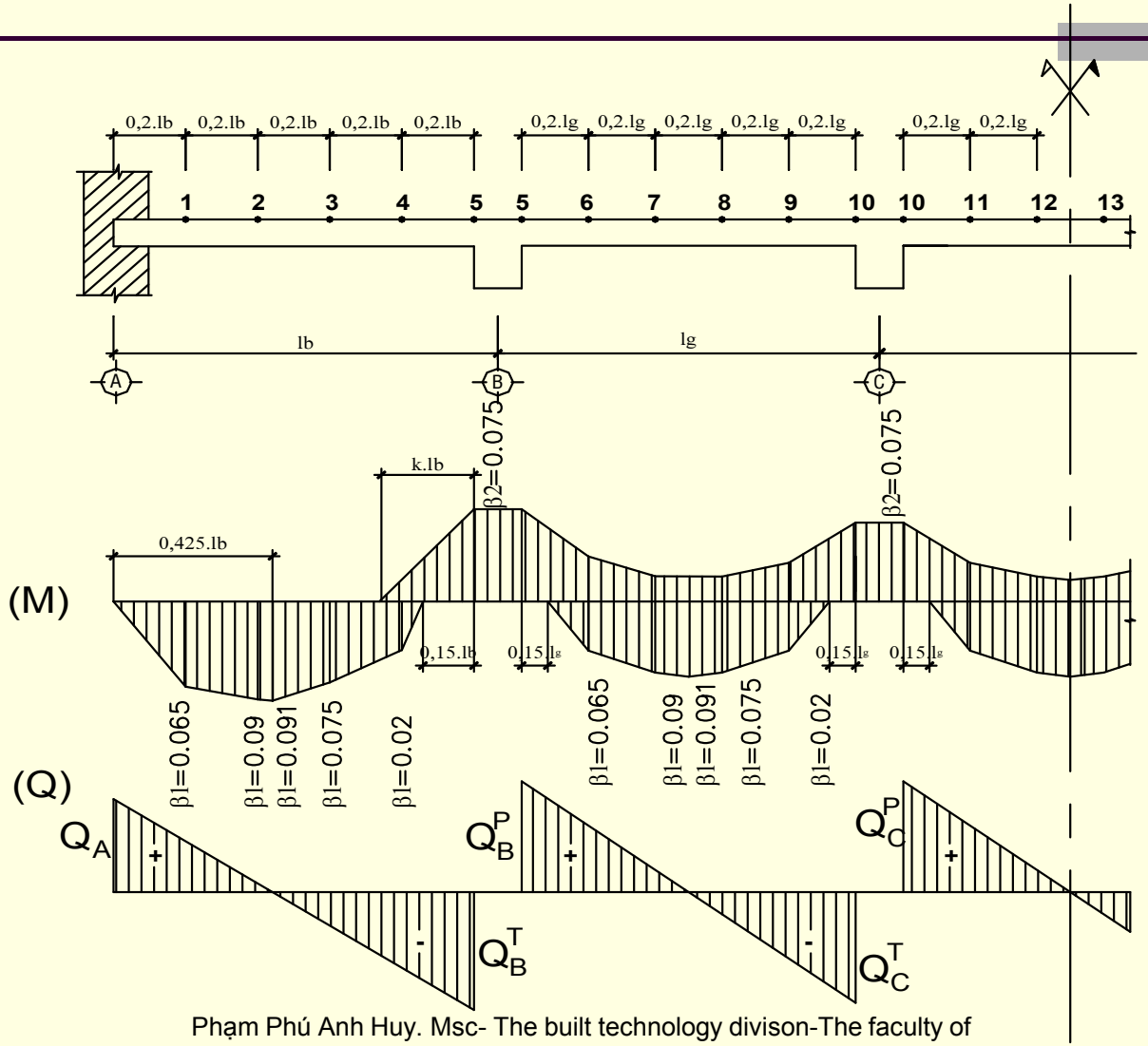
CHAPTER 3: THE BEAM DESIGN

3.5. THE LOAD

- Dead loads:
  - ✓The dead load of slab (g_b) transfer to it.
  - ✓The self-weight of beam.
  - ✓The self-weight of the beam-details.
  - ✓The self-weight of wall
- Live load: due to the live load of slab (p_b) transfer to itdo

CHAPTER 3: THE BEAM DESIGN

3.6. THE INTERNAL FORCE AND ENVELOPE DIAGRAM



CHAPTER 3: THE BEAM DESIGN

3.7. CALCULATE THE REINFORCEMENT AREA

The longitudinal-reinforcement area is calculated by the rectangular or T–tension reinforcement procedure

The stirrup and diagonal steel (can have not)

CHAPTER 3: THE BEAM DESIGN

3.8. CHOSSE THE TEMPERATURE AND SHINKAGE REINFORCEMENT

- The temperature and shinkage steel area is chosen >= 0,15 the beam-web area.
- Can use the temperature and shinkage steel to connect with the stirrup.
- When the beam-height is more than 700mm, we can use it and put it in the mid-height of beam

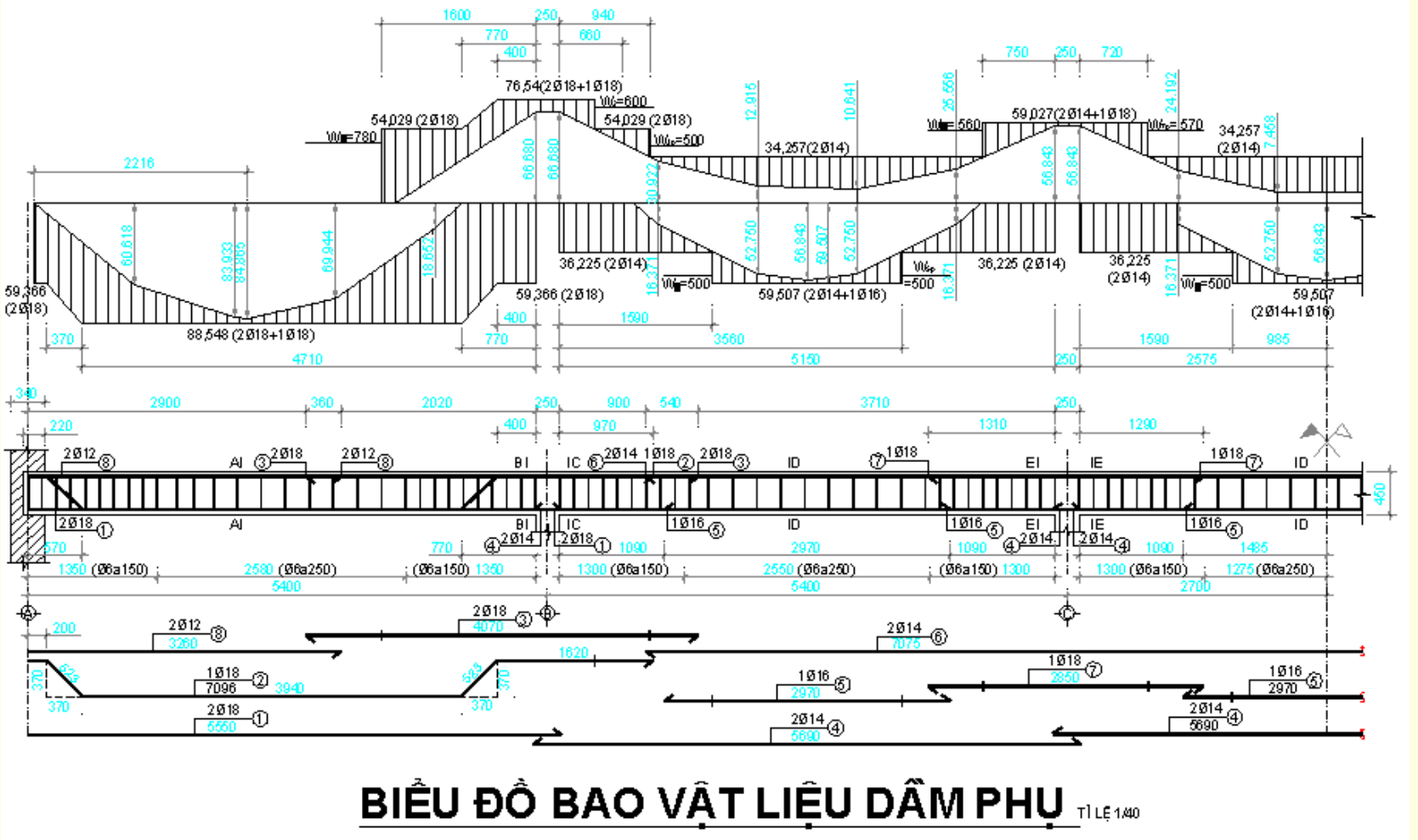
CHAPTER 3: THE BEAM DESIGN

3.9. CALCULATE VAD DRAW THE MATERIAL-DIAGRAM

1. Anticipate the bar is bent and cut
2. Calculate M_{td} (the ultimate-strength of the section): should present the table.
3. Choose the bend point and check bar-bend.
4. Calculate to cut the bar.
5. Draw the material diagram.

CHAPTER 3: THE BEAM DESIGN

3.10. THE DRAWING



CHAPTER 3: THE BEAM DESIGN

3.11. SUMURIZE THE MATERIAL

BẢNG THỐNG KÊ CỐT THÉP

Tên cấu kiện	Số hiệu thanh	Hình dáng	Đường kính (mm)	Số lượng thanh	Chiều dài 1 thanh (mm)	Chiều dài Tổng cộng (m)	Trọng lượng (kg)
DẦM PHỤ (SL:11)	1	5550	18	44	5550	244,2	488,912
	2	200 / 523 / 3940 / 523 / 1620	18	22	7096	156,11	311,908
	3	4070	18	44	4070	179,08	357,802
	4	5690	14	66	5690	375,54	453,652
	5	2970	16	33	2970	98,07	154,758
	6	7075	14	44	7075	311,30	376,050
	7	2850	18	22	2850	62,70	125,275
	8	3260	12	44	3260	143,44	127,375
	9	160 / 380 / 50 / 50	6	140	1180	165,20	36,674

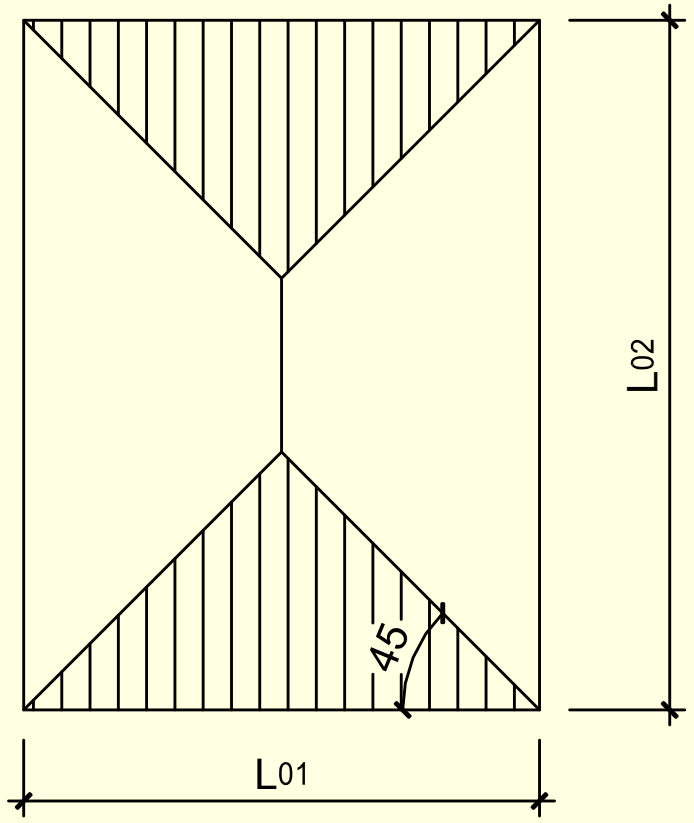
BẢNG TỔNG HỢP VẬT LIỆU

NHÓM CỐT THÉP	CI		CII							
ĐƯỜNG KÍNH (mm)	6	8	12	14	16	18	20	22	25	28
TRỌNG LƯỢNG (Kg)	3055,2	1027	127,4	1025,4	154,8	1405,1	116,8	312,7	1559,3	404,5

DESIGN THE BEAM ACCORDING TO THE PLASTIC METHOD

The two-way slab

- The loads transfer to the rule:

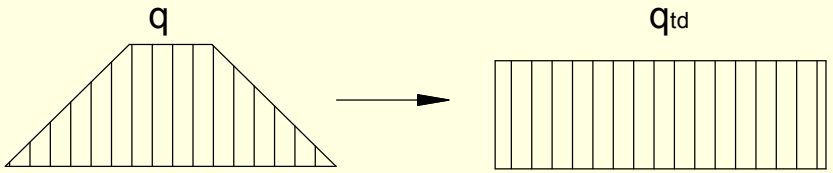


CHAPTER 3: THE BEAM DESIGN

DESIGN THE BEAM ACCORDING TO THE PLASTIC METHOD

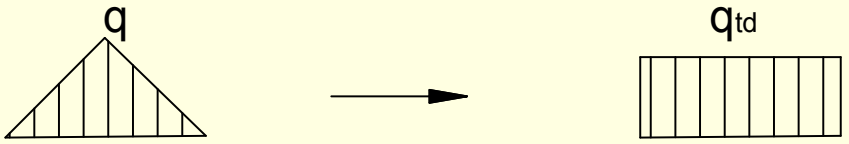
-Look up the calculation table to determine the moment and shear.

-Can change the triangular or trapezium loads to distributed loads:



$$q_{td} = q.(1 - 2.\beta^2 + 3.\beta^3)$$

$$\beta = \frac{l_1}{2.l_2}$$



$$q_{td} = \frac{5}{8}.q$$

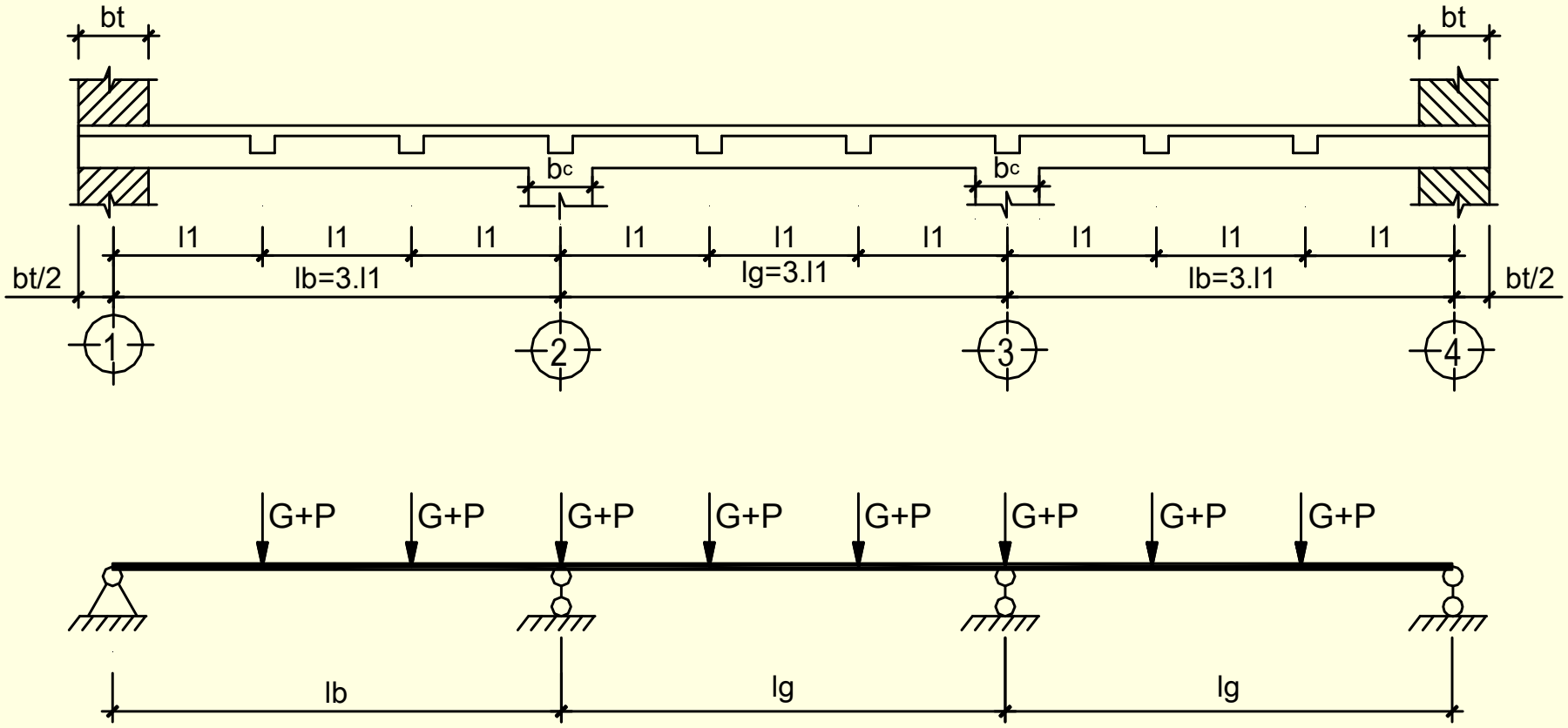
CHAPTER 4: THE GIRDER DESIGN

4.1. THE CALCULATION METHOD

- The girder is calculated by the elastic method

CHAPTER 4: THE GIRDER DESIGN

4.2. THE CALCULATION MODEL



CHAPTER 4: THE GIRDER DESIGN

4.3. CHOOSE PRELIMINARILY THE DIMENDIONS OF GIRDER SECTION (b_{dc}xh_{dc})

-It is chosen in chapter 1

CHAPTER 4: THE GIRDER DESIGN

4.4. THE CALCULATION SPANS

-The calculation span are chosen the spacing from center to center of support

The edge span: $l_b = 3l_1$

The internal span: $l_g = 3l_1$

CHAPTER 4: THE GIRDER DESIGN

4.5. THE LOADS

❖Dead loads:

✓The self-weight of beam: concentrated force (be at the beam-positions)

✓The dead load due to the beam transfer to it (is calculated the concentrated force)

❖Live load:

✓The live load due to the beam transfer to it (is calculated the concentrated force)

CHAPTER 4: THE GIRDER DESIGN

4.6. THE ENVELOPE INTERNAL FORCE DIAGRAMS

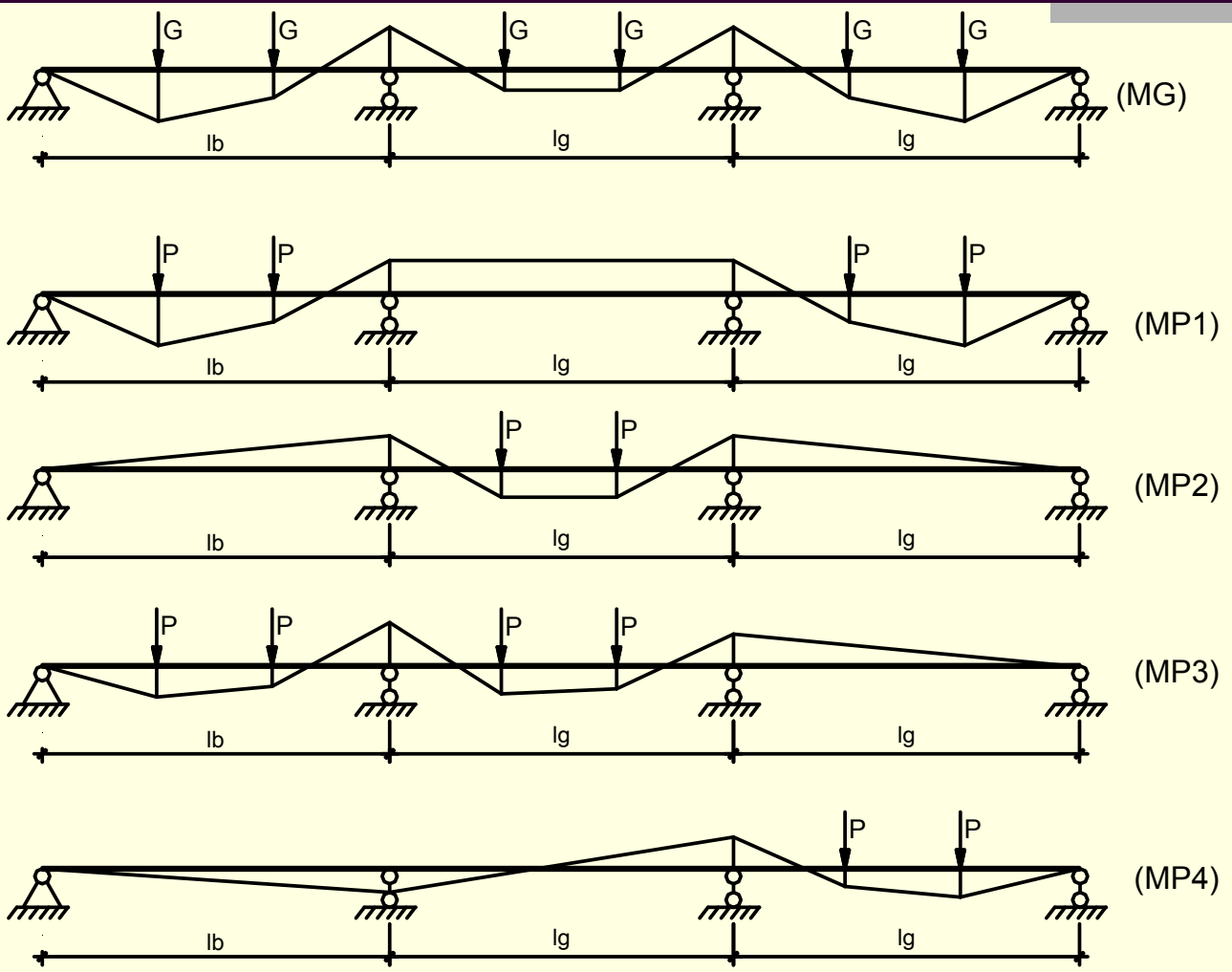
-There are 2 method:

- The load-combination
- The internal-force combination.

-The students can use the SAP2000 software to solve this problem

CHAPTER 4: THE GIRDER DESIGN

4.6. THE ENVELOPE INTERNAL FORCE DIAGRAMS



CHAPTER 4: THE GIRDER DESIGN

4.7. CALCULATE THE REINFORCEMENT AREA

-The longitudinal reinforcement

-The stirrup

-The diagonal steel

CHAPTER 4: THE GIRDER DESIGN

4.8. CHOOSE THE TEMPRATURE AND SHINKAGE STEEL

-The same the beam

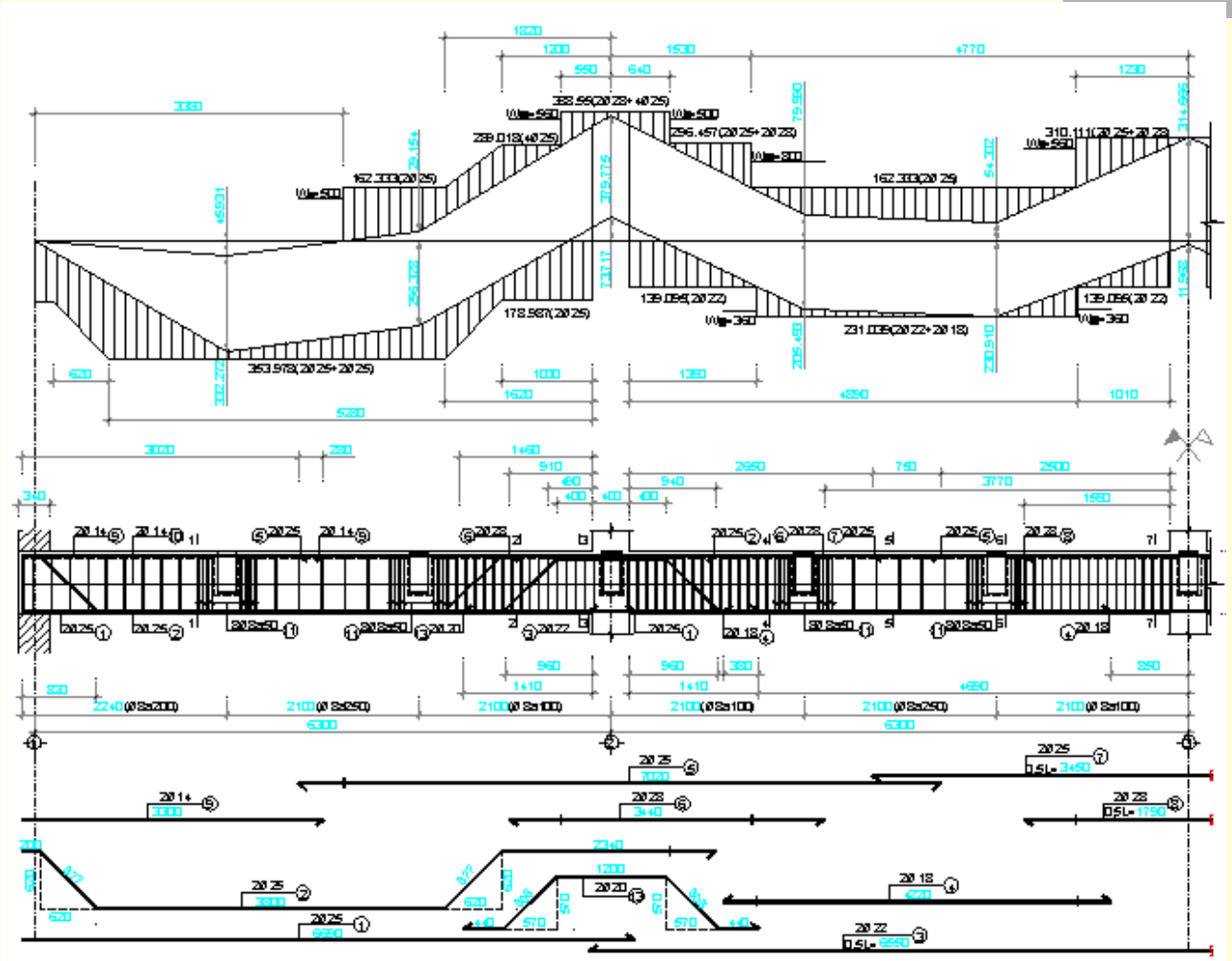
CHAPTER 4: THE GIRDER DESIGN

3.9. CALCULATE VAD DRAW THE MATERIAL-DIAGRAM

- The same the beam

CHAPTER 4: THE GIRDER DESIGN

4.10. THE DRAWING



CHAPTER 4: THE GIRDER DESIGN

4.11. SUMARIZE THE MATERIALS

BẢNG THỐNG KÊ CỐT THÉP

Tên cấu kiện	Số hiệu thanh	Hình dáng	Đường kính (mm)	Số lượng thanh	Chiều dài 1 thanh (mm)	Chiều dài Tổng cộng (m)	Trọng lượng (kg)
DẦM CHÍNH (SL:4)	1	6690	25	16	6900	107,04	412,425
	2	200 3800 2340	25	16	7884	126,14	486,017
	3	13100	22	8	13100	104,80	312,723
	4	4220	18	16	4220	67,52	134,905
	5	7020	25	16	7020	112,32	432,769
	6	3440	28	16	3440	55,04	266,063
	7	6900	25	8	6900	55,20	212,686
	8	3580	28	8	3580	28,64	138,446
	9	3420	14	16	3420	54,72	66,102
	10	11700 1710	14	8	13410	107,28	129,594
	11	80 210 50 630	8	720	1780	1281,60	506,232
	12	210 50 50	8	336	310	104,16	41,143
	13	1200 440 440	20	16	2960	47,36	116,79

BẢNG TỔNG HỢP VẬT LIỆU

NHÓM CỐT THÉP	CI		CII							
ĐƯỜNG KÍNH (mm)	6	8	12	14	16	18	20	22	25	28
TRỌNG LƯỢNG (Kg)	3055,2	1027	127,4	1025,4	154,8	1405,1	116,8	312,7	1559,3	404,5

CHAPTER 5: THE DRAWING

5.1. SUMARIZE THE DESIGN-DATA

-We sumarize all the design data: slab, beam, girder design data.

-From it, we can draw all the data in the drawing

CHAPTER 5: THE DRAWING

5.2. DRAW THE DRAWING

-Layer, drawing-line, font, size…
-Scale
-The contents is preseted in the drawing

CHAPTER 5: THE DRAWING

5.2. DRAW THE DRAWING