โครงการพัฒนาพื้นที่ส่วนขยาย
ศูนย์ราชการเฉลิมพระเกียรติ ๘๐ พรรษา ๕ ธันวาคม ๒๕๕๐ พื้นที่โซน C
บริษัท ธนารักษ์พัฒนาสินทรัพย์ จำกัด

แบบรายละเอียดฉบับสมบูรณ์ (Final Detailed Design)
สัญญาก่อสร้างอาคารทิศตะวันตก
(ส่วนงานโครงสร้าง งานสถาปัตยกรรม และงานระบบหลัก)

รายงานการออกแบบ Design Note รายการคำนวณ
งานโครงสร้าง

(REVISION 0)

จัดทำโดย

GCDT
GOVERNMENT CENTER DESIGN TEAM

1 เมษายน 2564

เจ้าของโครงการ	: บริษัท ธนารักษ์พัฒนาสินทรัพย์ จำกัด	จำนวนหน้า (รวมปก)	ส่งถึง
อาคาร	: อาคารทิศตะวันตก		
โครงการ	: พัฒนาพื้นที่ส่วนขยายศูนย์ราชการฯ พื้นที่โซน C		
สถานที่ก่อสร้าง	: ศูนย์ราชการเฉลิมพระเกียรติ ๘๐ พรรษา ๕ ธันวาคม ๒๕๕๐ ถนนแจ้งวัฒนะ กรุงเทพฯ		

รายการคำนวณโครงสร้าง

อาคารทิศตะวันตก

REV.	โดย	วันที่	ตรวจสอบ.	วันที่	อนุมัติ	วันที่		
								PURPOSE
								INFORMATION
								PRELIMANARY
								REVIEW
								APPROVAL
A	โชคชัย	10/01/21	นพดล	15/01/21	ชนินทร	19/01/21	X	CONSTRUCTION
								AS BUILT

บริษัท ไดนามิค เอ็นยิเนียริ่ง คอนซัลแตนทส์ จำกัด
DYNAMIC ENGINEERING CONSULTANTS CO., LTD.

SPECIALIST STAMP

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หน่วยงาน	หมายเลขโครงการ	หมายเลขเอกสาร	REV. NO.	ส่งวันที่
โครงสร้าง	193018	CAL-ST-001	-	20/01/21


ใบอนุญาตประกอบวิชาชีพวิศวกรรมควบคุม
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เลขประจำตัวประชาชน (ID) 3-10050-1-293-72-1
ชื่อตัวและชื่อสกุล นาย โชคชัย ขัดขจร
Title/Name Surname Mr. Chokchai Khatkhajorn
เลขทะเบียน License No. สย.4522
เลขที่สมาชิกสามัญ Member No.
ระดับ Level ความชำนาญวิศวกร Professional Eng.
สาขา Discipline Civil Eng.
วันที่ออกใบอนุญาต Date of Issue 7 ธ.ค. 2563 7 Dec 2020
วันบัตรหมดอายุ Date of Expiry 6 ธ.ค. 2568 6 Dec 2025
นายสุพัชรีวิ์ สุวรรณสวัสดิ์
นายกสภาวิศวกร President

สำหรับรับรองรายการคำนวณออกแบบ อาคารทิศตะวันตก
โครงการพัฒนาพื้นที่ส่วนขยายศูนย์รายการเฉลิมพระเกียรติ 80 พรรษา
5 ธันวาคม 2550 พื้นที่โซน C
สำเนาถูกต้อง


สภาวิศวกร
๓๐ พฤศจิกายน ๒๕๕๖
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สารบัญ

หมวด

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1. เกณฑ์กำหนดในการออกแบบ (Design Criteria)

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หมวดที่ 1
ข้อกำหนดที่ใช้ในการออกแบบ (Design Criteria)

1. มาตรฐาน พระราชบัญญัติ และข้อบัญญัติที่ใช้อ้างอิง (Standards and Codes)

ในการออกแบบโครงสร้างคอนกรีตเสริมเหล็กใช้ทฤษฎีกำลังประลัย (Ultimate Strength Design) สำหรับโครงสร้างเหล็กใช้วิธีหน่วยแรงที่ยอมให้ (Allowable Strength Design) โดยจะยึดถือตามกฎหมายที่เกี่ยวข้อง และมาตรฐานของสมาคมวิชาชีพ ดังนี้

- พระราชบัญญัติควบคุมอาคาร พ.ศ 2522 และกฎกระทรวงที่ออกตามความในพระราชบัญญัติฉบับนี้
- ข้อบัญญัติกรุงเทพมหานคร เรื่องควบคุมอาคาร พ.ศ. 2544
- มาตรฐานสำหรับอาคารคอนกรีตเสริมเหล็กโดยวิธีกำลังของวิศวกรรมสถานแห่งประเทศไทยในพระบรมราชูปถัมภ์
- มาตรฐานสำหรับอาคารเหล็กรูปพรรณ ของวิศวกรรมสถานแห่งประเทศไทยในพระบรมราชูปถัมภ์
- มาตรฐานประกอบการออกแบบอาคารเพื่อต้านทานการสั่นสะเทือนของแผ่นดินไหว มยผ. 1302-52 กรมโยธาธิการและผังเมือง, กระทรวงมหาดไทย
- มาตรฐานประกอบการออกแบบอาคารเพื่อต้านทานการสั่นสะเทือนของแผ่นดินไหว ปรับปรุงครั้งที่ 1 มยผ.1301-54 กรมโยธาธิการและผังเมือง, กระทรวงมหาดไทย
- มาตรฐานการออกแบบอาคารเพื่อต้านทานการสั่นสะเทือนของแผ่นดินไหว มยผ.1301/1302-61
- มาตรฐานการคำนวณแรงลมและการตอบสนองของอาคาร, มยผ.1311-50 กรมโยธาธิการและผังเมือง, กระทรวงมหาดไทย
- American Society of Civil Engineer, Minimum Design Loads for Buildings and Other Structures (ASCE/SEI 7)
- American Society for Testing and Material (ASTM)
- Precast-Prestressed Concrete Institute (PCI)
- ACI Committee 318, "Building Code Requirement for Reinforced Concrete" (ACI 318)
- American Institute of Steel Construction, "Steel Construction Manual" (AISC)
- Uniform Building Code (UBC)
- ACI Committee 350, "Code Requirements for Environmental Engineering Concrete Structures"
- International Building Code (IBC)

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2. กำลังวัสดุที่ใช้ในการออกแบบ

กำลังวัสดุที่ใช้ในการคำนวณหรือควบคุมคุณภาพวัสดุ จะใช้ค่าต่าง ๆ ดังต่อไปนี้

(1) คอนกรีต ค่ากำลังต้านทานแรงอัด (Compressive Strength: fc') ของคอนกรีตรูปทรงกระบอกมาตรฐานเส้นผ่าศูนย์กลาง 0.15 ม. สูง 0.30 ม. ที่อายุครบ 28 วัน มีค่าดังนี้

- คอนกรีตอัดแรง fc' ไม่น้อยกว่า 350 กก./ตร.ซม.
- คอนกรีตเสริมเหล็กทั่วไป fc' ไม่น้อยกว่า 350 กก./ตร.ซม.

(2) เหล็กเสริมและเหล็กรูปพรรณ ค่าแรงดึงที่จุดคลาก (Yield Strength: fy) ของเหล็กมีค่าดังนี้

- เหล็กข้ออ้อย ตามมาตรฐานผลิตภัณฑ์อุตสาหกรรม (มอก.) 24-2559 ของกระทรวงอุตสาหกรรม ชั้นคุณภาพ SD-40 มีค่า fy ไม่น้อยกว่า 4,000 กก./ตร.ซม.ซม. สำหรับเหล็กเสริม ขนาดเส้นผ่าศูนย์กลาง 12 มม. ถึง 28 มม.
- เหล็กข้ออ้อย ตามมาตรฐานผลิตภัณฑ์อุตสาหกรรม (มอก.) 24-2559 ของกระทรวงอุตสาหกรรม ชั้นคุณภาพ SD-50 มีค่า fy ไม่น้อยกว่า 5,000 กก./ตร.ซม. สำหรับเหล็กเสริม ขนาดเส้นผ่าศูนย์กลาง 32 มม.
- เหล็กเส้นกลม ตามมาตรฐานผลิตภัณฑ์อุตสาหกรรม (มอก.) 20-2559 ชั้น คุณภาพ SR-24 มีค่า fy ไม่น้อยกว่า 2,400 กก./ตร.ซม.
- เหล็กที่เกลียวกำลังสูงชนิด 7 เส้น (PC Strand) ตามมาตรฐานผลิตภัณฑ์อุตสาหกรรม (มอก.) 420-2540
- เหล็กรูปพรรณชนิด Hot-rolled of Cold rolled Mild Steel ชั้นคุณภาพ SS-400 ตามมาตรฐานอุตสาหกรรมไทย มอก.1227-2558 โดยมีค่าแรงดึงที่จุดคราก (Yield Strength: Fy) มีค่าไม่น้อยกว่า 2,350 กก./ ตร.ซม.
- เหล็กรูปพรรณชนิด Hot-rolled of Cold rolled Mild Steel ชั้นคุณภาพ HS-41 ตามมาตรฐานอุตสาหกรรมไทย มอก.107-2533 โดยมีค่าแรงดึงที่จุดคราก (Yield Strength: Fy) มีค่าไม่น้อยกว่า 2,350 กก./ ตร.ซม.

3. น้ำหนักบรรทุกใช้งานในการออกแบบ (Design Load)

(1) น้ำหนักบรรทุกคงที่ (Dead Load: DL)

- น้ำหนักคอนกรีต	=	2400	กก./ลบ.ม.
- น้ำหนักเหล็กรูปพรรณ	=	7850	กก./ลบ.ม.
- น้ำหนักผนังก่ออิฐมวลเบา	=	100	กก./ตร.ม
- น้ำหนักผนังก่ออิฐบล็อก	=	180	กก./ตร.ม
- น้ำหนักผนังกระจก	=	100	กก./ตร.ม
- น้ำหนักผนังก่ออิฐมอญเต็มแผ่น	=	360	กก./ตร.ม
- น้ำหนักผนังก่ออิฐมอญครึ่งแผ่น	=	180	กก./ตร.ม
- กระเบื้องยางปูพื้น	=	5	กก./ตร.ม
- กระเบื้องเซรามิคปูพื้น	=	15-20	กก./ตร.ม

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- ฝ้าเพดานยิบซั่มบอร์ดโครงเคร่าโลหะ = 30 กก./ตร.ม
- น้ำหนักเครื่องจักรฯ รับวัสดุอื่น ๆ ให้คำนวณจากข้อมูลจริง

(2) น้ำหนักบรรทุกคงที่เพิ่มเติม (Superimposed Dead Load: SDL)

- พื้นที่ลานอเนกประสงค์ = 120 กก./ตร.ม
- พื้นที่สำนักงาน = 120 กก/ตร.ม
- ห้องประชุม, ห้องเอนกประสงค์, ภัตตาคาร = 120 กก/ตร.ม
- สวนบนหลังคา = 1,200 กก./ตร.ม

(3) น้ำหนักบรรทุกจร (Live Load: LL)

- หลังคาเบา = 50 กก./ตร.ม
- กันสาดหรือหลังคาคอนกรีตเสริมเหล็ก = 200 กก./ตร.ม
- พื้นที่สำนักงาน = 300 กก./ตร.ม
- ห้องประชุม, ห้องอเนกประสงค์, ภัตตาคาร = 400 กก./ตร.ม
- บันได ช่องทางเดินห้องประชุม, ภัตตาคาร = 500 กก./ตร.ม
- ห้องเก็บของ (ไม่น้อยกว่า) = 500 กก./ตร.ม
- สวนบนหลังคา = 400 กก./ตร.ม
- ที่จอดรถยนต์ = 400 กก./ตร.ม
- พื้นที่อาคารศูนย์ประชุม = 500 กก./ตร.ม
- ห้องเก็บสำนวนคดี = 1,000 กก./ตร.ม
- ห้องไฟฟ้า = 300* กก./ตร.ม
- ห้อง AHU = 500* กก./ตร.ม
- ห้องเครื่อง Pump = 800* กก./ตร.ม
- ห้องหม้อแปลง, เครื่องกำเนิดไฟฟ้า, = 2,000* กก./ตร.ม
- Chiller, Cooling Tower
- ห้องเครื่องลิฟต์ = 2,000* กก./ตร.ม

<u>หมายเหตุ</u> น้ำหนักบรรทุกจร * ที่เสนอจะต้องตรวจสอบอีกครั้งเมื่อมีข้อมูลน้ำหนักที่แท้จริงของอุปกรณ์แล้ว

(4) แรงลม (Wind Load, WL)

4.1 ตามข้อบัญญัติกรุงเทพมหานคร เรื่องควบคุมอาคาร พ.ศ. 2544 กำหนดให้ค่าหน่วยแรงลมออกแบบมีความสัมพันธ์กับความสูงของอาคารและมีค่าไม่น้อยกว่าค่าที่ระบุในตารางต่อไปนี้

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ความสูงของอาคารหรือส่วนของอาคาร	หน่วยแรงลมอย่างน้อย กิโลกรัมต่อตารางเมตร
ส่วนของอาคารที่สูงไม่เกิน 10 เมตร	50
ส่วนของอาคารที่สูงกว่า 10 เมตร แต่ไม่เกิน 20 เมตร	80
ส่วนของอาคารที่สูงกว่า 20 เมตร แต่ไม่เกิน 40 เมตร	120
ส่วนของอาคารที่สูงเกิน 40 เมตร แต่ไม่เกิน 80 เมตร	160
ส่วนของอาคารที่สูงเกินกว่า 80 เมตร	200

4.2 ตามมาตรฐานการคำนวณแรงลมและการตอบสนองของอาคาร (มยผ. 1311-50)

(5) การลดน้ำหนักบรรทุกจรของอาคาร

ในการคำนวณน้ำหนักที่ถ่ายลงเสาและฐานราก ให้ใช้น้ำหนักของอาคารเต็มอัตราจริงส่วนน้ำหนักบรรทุกจร (Live Load) ให้ลดส่วนลงได้ตามชั้นของอาคารดังต่อไปนี้

ตารางที่ 1 อัตราการลดน้ำหนักบรรทุกบนพื้นแต่ละชั้นของอาคาร

การรับน้ำหนักของพื้น	อัตราการลดน้ำหนักบรรทุกบนพื้นแต่ละชั้นเป็นร้อยละ
หลังคาหรือดาดฟ้า	0
ชั้นที่หนึ่งถัดจากหลังคาหรือดาดฟ้า	0
ชั้นที่สองถัดจากหลังคาหรือดาดฟ้า	0
ชั้นที่สามถัดจากหลังคาหรือดาดฟ้า	10
ชั้นที่สี่ถัดจากหลังคาหรือดาดฟ้า	20
ชั้นที่ห้าถัดจากหลังคาหรือดาดฟ้า	30
ชั้นที่หกถัดจากหลังคาหรือดาดฟ้า	40
ชั้นที่เจ็ดถัดจากหลังคาหรือดาดฟ้า และชั้นต่อลงไป	50

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สำหรับห้องประชุม, ห้องเอนกประสงค์, ห้องเก็บของ, ที่จอดรถยนต์ให้คิดน้ำหนักบรรทุกเต็มอัตราทุกชั้น

(6) แรงแผ่นดินไหว (Earthquake Load, E)

ตามกฎกระทรวง พ.ศ. 2550 ได้กำหนดการรับน้ำหนัก ความต้านทาน ความคงทนของอาคารและพื้นดินที่รองรับอาคารในการต้านแรงสั่นสะเทือนของแผ่นดินไหว ตามความในพระราชบัญญัติควบคุมอาคาร พ.ศ. 2522 และมีผลบังคับใช้ตั้งแต่วันที่ 30 พฤศจิกายน 2550 ซึ่งกฎกระทรวงดังกล่าวได้แก้ไข เพิ่มเติมและยกเลิกกฎกระทรวงฉบับที่ 49 (พ.ศ. 2540) ตามความในพระราชบัญญัติควบคุมอาคาร พ.ศ. 2522 ว่าด้วยการออกแบบโครงสร้างจะต้องออกแบบรับแรงแผ่นดินไหว เนื่องจากโครงการอยู่ในเขตที่อาคารออกแบบอาคารรับ

แรงเนื่องจากแผ่นดินไหว ซึ่งตามกฎกระทรวงที่กำหนดให้พื้นที่หรือบริเวณเฝ้าระวัง บริเวณที่ 1 และบริเวณที่ 2 สำหรับอาคารที่จำเป็นต่อความเป็นอยู่ของสาธารณชนจะต้องออกแบบโครงสร้างต้านทานแรงแผ่นดินไหว

"บริเวณเฝ้าระวัง" หมายถึง พื้นที่หรือบริเวณที่อาจได้รับผลกระทบจากแผ่นดินไหว ได้แก่ จังหวัดกระบี่ จังหวัดชุมพร จังหวัดพังงา จังหวัดภูเก็ต จังหวัดระนอง จังหวัดสงขลา และจังหวัดสุราษฎร์ธานี

"บริเวณที่ 1" หมายถึง พื้นที่หรือบริเวณที่เป็นดินอ่อนมากที่อาจได้รับผลกระทบจากแผ่นดินไหวระยะไกล ได้แก่ กรุงเทพมหานคร จังหวัดนนทบุรี จังหวัดปทุมธานี จังหวัดสมุทรปราการ และจังหวัดสมุทรสาคร

"บริเวณที่ 2" หมายถึง พื้นที่หรือบริเวณที่อยู่ใกล้รอยเลื่อนที่อาจได้รับผลกระทบจากแผ่นดินไหว ได้แก่ จังหวัดกาญจนบุรี จังหวัดเชียงราย จังหวัดเชียงใหม่ จังหวัดตาก จังหวัดน่าน จังหวัดพะเยา จังหวัดแพร่ จังหวัดแม่ฮ่องสอน จังหวัดลำปาง และจังหวัดลำพูน

ซึ่งโครงการก่อสร้างนี้ตั้งอยู่ในจังหวัดกรุงเทพมหานคร เป็นเขตเสี่ยงต่อแผ่นดินไหวอยู่ในบริเวณที่ 1 จำเป็นต้องออกแบบระบบโครงสร้างที่คำนึงถึง แรงเนื่องจากแผ่นดินไหวด้วย โดยการออกแบบอาคารให้อ้างอิงตามมาตรฐานประกอบการออกแบบอาคารเพื่อต้านการสั่นสะเทือนของแผ่นดินไหว ปี พ.ศ. 2552 (มยผ. 1302-52) , ปี พ.ศ. 2554 (มยผ. 1301-54) และ ปี พ.ศ. 2561 (มยผ. 1301/1302-61)

(7) แรงเนื่องจากการทรุดตัวที่แตกต่างกัน (Differential Settlement, S)

เป็นแรงกระทำต่อโครงสร้างเนื่องจากการทรุดตัวที่แตกต่างกันของฐานรากอาคาร ซึ่งในการออกแบบโครงสร้างอาคารนี้จะพิจารณาถึงผลอันเนื่องมาจากการทรุดตัวที่แตกต่างกันของฐานรากที่ไม่ก่อให้เกิดการแตกร้าวของโครงสร้างอาคาร

(8) แรงดันดิน (H)

เป็นแรงกระทำต่อโครงสร้างทางด้านข้างในการออกแบบโครงสร้างอาคารจะพิจารณาถึงผลกระทบที่เกิดจากแรงดันดินดังกล่าว ดังนี้

For Sand or Sandy Clay

Ka	=	tan2 (45 - ϕ/2)	Coefficient to active earth pressure.
Ko	=	tan2 (45+ ϕ/2)	Coefficient of passive earth pressure.
Kp	=	1 – sin ϕ	Coefficient of earth pressure at rest.
ϕ	=	Angle of internal friction	

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For clay, $\phi = 0$

Active soil pressure, Pa = $\gamma h - 2C$

Passive soil pressure, Pp = $\gamma h + 2C$

γ = Density of Soil

C = Co-efficient of Cohesion

Unless otherwise noted, the lateral soil pressure coefficients are:

Active soil pressure coefficient, Ka = 0.33

At-rest soil pressure coefficient, Ko = 0.50

Passive soil pressure coefficient, Kp = 3.00

(9) แรงเนื่องจากการเปลี่ยนแปลงของอุณหภูมิ (Temperature Change, T)
เป็นแรงกระทำที่ทำให้เกิดการยืดหดตัวของโครงสร้าง โดยการเปลี่ยนแปลงของอุณหภูมิจะอยู่ที่ ±15 องศาเซลเซียส ในการออกแบบโครงสร้างอาคารซึ่งเป็นอาคารช่วงยาว จะพิจารณาถึงผลที่เกิดจากการเปลี่ยนแปลงของอุณหภูมิที่ไม่ก่อให้เกิดการแตกร้าวของโครงสร้างอาคาร

4. การรวมน้ำหนักบรรทุกต่าง ๆ

(1) การออกแบบอาคารคอนกรีตเสริมเหล็กโดยวิธีกำลัง (Ultimate Strength Design) ตามกฎกระทรวงและมาตรฐาน (ACI 318)

<u>สัญลักษณ์ (Symbols)</u>

DL = ผลที่เกิดจากน้ำหนักบรรทุกคงที่ (Dead Load)

LL = ผลที่เกิดจากน้ำหนักบรรทุกจร (Live Load)

WL = ผลที่เกิดจากแรงลม (Wind Load)

E = ผลที่เกิดจากแรงแผ่นดินไหว (Seismic Load Effects)

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<u>กำลังที่ต้องการ</u>

U	=	1.7DL + 2.0 LL	(กฎกระทรวงฉบับที่ 6 พ.ศ.2527)
U	=	0.75(1.7DL + 2.0LL + 2.0WL)	(กฎกระทรวงฉบับที่ 6 พ.ศ.2527)
U	=	0.90DL + 1.30WL	(กฎกระทรวงฉบับที่ 6 พ.ศ.2527)
U	=	0.75(1.7DL + 2.0LL + 2.0EQ)	(กฎกระทรวง พ.ศ.2550)
U	=	0.90DL + 1.3EQ	(กฎกระทรวง พ.ศ.2550)
U	=	1.2DL + 1.0LL + 1.0EQ	(มยผ.1302-52 และ มยผ. 1302-54)
U	=	0.75(1.4DL + 1.7LL) + 1.0EQ	(มยผ.1301/1302-61)
U	=	0.90DL + 1.0EQ	(มยผ.1302-52,มยผ. 1302-54 และ มยผ. 1301/1302-61)

U	=	1.4DL + 1.7 LL	(EIT 1008-38)
U	=	0.75(1.4DL + 1.7LL + 1.7WL)	(EIT 1008-38)
U	=	0.75(1.4DL + 1.7LL + 1.87EQ)	(EIT 1008-38)
U	=	0.90DL + 1.43EQ	(EIT 1008-38)

<u>ตัวคูณลดกำลัง (Strength Reduction Factor)</u>

-	สำหรับแรงดัด	0.90
-	สำหรับแรงเฉือนและแรงบิด	0.85
-	สำหรับแรงอัดตามแนวแกน, เหล็กปลอกเดี่ยว	0.70
-	สำหรับแรงอัดตามแนวแกน, เหล็กปลอกเกลียว	0.75

<u>Flexural Strength Design</u>

$$\rho_b = 0.85 \text{ x } \beta_1 \text{x} \frac{fc'}{f_y} \text{x} \frac{6120}{(6120 + f_y)}$$

$$\beta_1 = 0.85 - 0.05\text{x}\frac{(fc' - 280)}{70}; \beta_1 < 0.85$$

$$\rho_{max} = 0.75\rho_b$$

$$\boldsymbol{\rho_{min}} = \frac{\mathbf{14}}{\boldsymbol{f_y}}$$; for beam and footing

= 0.0018 ; for slab where Grade SD40 deformed bars are used

= 0.0025 ; for slab where Grade SR24 round bars are used

$$R = \mathbf{0.75}\boldsymbol{\rho_b f_y}\left(\mathbf{1 - 0.44}\boldsymbol{\rho_b}\frac{\boldsymbol{f_y}}{\boldsymbol{fc'}}\right)$$

$$\boldsymbol{\phi M_n} = \boldsymbol{\phi R b d^2}$$

For single reinforcement: ($M_u < \phi M_n$)

$$\rho = 0.85\frac{fc'}{f_y}\text{x}\left(1 - \sqrt{1 - \frac{236M_u}{\sqrt{\phi bd^2 fc'}}}\right)$$

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Shear Strength Design

For beam shear strength

$$V_c = 0.53\sqrt{fc'}.bd$$

For punching shear strength

$$V_c = 1.06\sqrt{fc'}.b_o d$$

Compressive Strength Design

$$\phi V_n = 0.80\phi\left(0.85fc'\left(A_g - A_s\right) + A_s f_y\right)$$

Where

ϕ = Strength reduction factor

= 0.90 for flexure

= 0.85 for shear

= 0.70 for axial compression

Where

Ag	=	Gross area of member (cm^2)
As	=	Area of reinforcing steel (cm^2)
M_u	=	Ultimate moment (kg-m)
M_n	=	Nominal flexural strength (kg-m)
P_n	=	Nominal Compressive strength (kg)
R	=	Flexural resistance factor (kg/cm^2)
V_u	=	Ultimate shear force (kg)
V_c	=	Concrete shear strength (kg)
B	=	member width (cm)
b_o	=	Critical perimeter (cm)
d	=	Effective depth of member (cm)
fc'	=	Compressive strength of concrete (kg/cm^2)
fy	=	Yield strength of reinforcing steel (kg/cm^2)
h	=	Depth of member (cm)
β_1	=	Concrete stress block parameter
ρ	=	Reinforcement ratio = As / bd
ρ_b	=	Balanced steel ratio

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(2) การออกแบบโครงสร้างเหล็กโดยวิธีหน่วยแรงที่ยอมให้ (Allowable Stress Design-ASD) ตามกฎกระทรวงและมาตรฐาน (AISC)

<u>สัญลักษณ์ (Symbols)</u>

DL	=	ผลที่เกิดจากน้ำหนักบรรทุกคงที่ (Dead Load)
LL	=	ผลที่เกิดจากน้ำหนักบรรทุกจร (Live Load)
WL	=	ผลที่เกิดจากแรงลม (Wind Load)
E	=	ผลที่เกิดจากแรงแผ่นดินไหว (Seismic Load Effects)

<u>กำลังที่ต้องการ</u>

U	=	DL + LL	
U	=	0.75(DL + LL + WL)	
U	=	0.75(DL + LL + EQ)	
U	=	1.0DL + 0.7EQ	(มยผ.1302-52 และ มยผ. 1301/1302-61)
U	=	1.0DL + 0.75LL + 0.525EQ	(มยผ.1302-52 และ มยผ. 1301/1302-61)
U	=	0.6DL + 0.7EQ	(มยผ.1302-52 และ มยผ. 1301/1302-61)

<u>Allowable Flexural Stress</u>

1. Members with Unbraced length not exceed the value of L_c

$$F_b = 0.66F_y$$

Where $L_c = \dfrac{637b_f}{\sqrt{F_y}}$ or $\dfrac{1406000}{(d/A_f)F_y}$

Whichever is smaller

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2. Members with Unbraced length greater than Lc

When $\sqrt{\dfrac{717x10^4C_b}{F_y}} < \dfrac{I}{r_T} < \sqrt{\dfrac{3585x10^4C_b}{F_y}}$

$$F_b = \left(\frac{2}{3} - \frac{F_y(I/r_T)^2}{10755x10^4C_b}\right)F_y < 0.60F_y$$

When $\dfrac{I}{r_T} = \sqrt{\dfrac{3585x10^4C_b}{F_y}}$

$$F_b = \frac{1195x10^4C_bF_y}{(I/r_T)^2} < 0.60F_y$$

F_t	=	Allowable axial tensile stress (kg/cm^2)
F_v	=	Allowable shear stress (kg/cm^2)
Fy	=	Specified minimum yield stress of the type of steel being used (kg/cm^2)
K	=	Effective length factor
b_f	=	Flange width of rolled beam (cm)
d	=	depth of beam (cm)
l	=	Unbraced length of member (cm)
r	=	radius of gyration (cm)
r_T	=	radius of gyration of a section comprising the compression flange plus 1/3 of the compression web area, taken about an axis in the plane of the web (cm).

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2. รายการคำนวณเสา, กำแพง

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DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-1 1st

Project : อาคารทิศตะวันตก

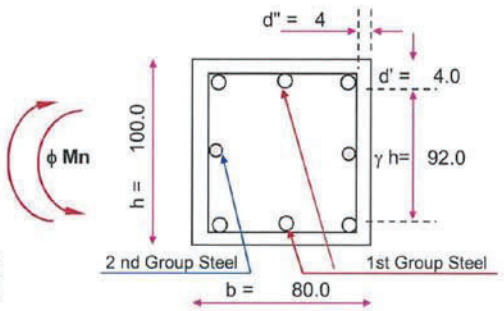
filename : COLUMN

Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	1550	[T]		
Moment	ϕ Mn	=	155	[T-m]		
Separate Steel 2 group	1 st.	=	28	As =	172.4	[cm^2]
	2 nd.	=	28	As =	172.4	[cm^2]
Steel Reinforcement	No.	=	56			
	d	=	96	[cm]		
d (εu / (εy + εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.043	OK		

Main Steel Used 56 DB 28 — DB 28

Stirrup DB 12 @ 0.400 — DB 12

e b = 0.47 [cm]



Clumn (80 x 100)

Steel 56 DB 28

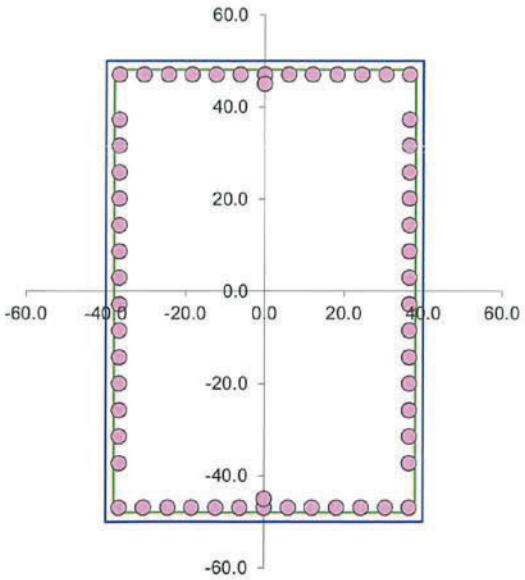
Stirrup DB 12 @ 0.400

Boundary of tie stirrup Column

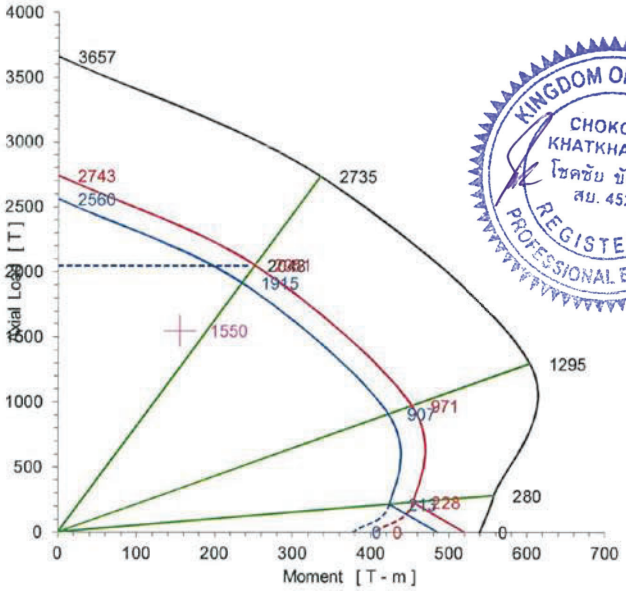
Boundary of sprial stirrup Column

Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



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Column C-1 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-1 2nd-3rd

Project : อาคารทิศตะวันตก

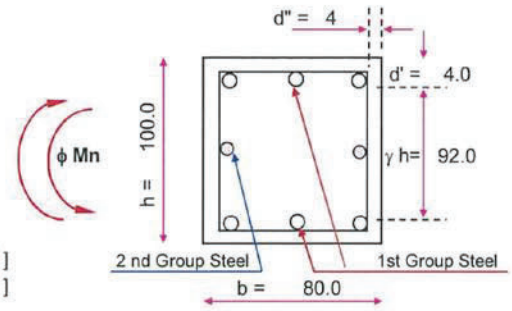
filename : COLUMN

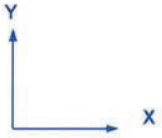
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	1450	[T]		
Moment	ϕ Mn	=	145	[T-m]		
Separate Steel 2 group	1 st.	=	20	As =	123.2	[cm^2]
	2 nd.	=	28	As =	172.4	[cm^2]
Steel Reinforcement	No.	=	48			
	d	=	96	[cm]		
d (εu / (εy + εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.037	OK		

Main Steel Used 48 DB 28 — DB 28

Stirrup DB 12 @ 0.400 — DB 12

e b = 0.40 [cm]





Clumn (80 x 100)

Steel 48 DB 28

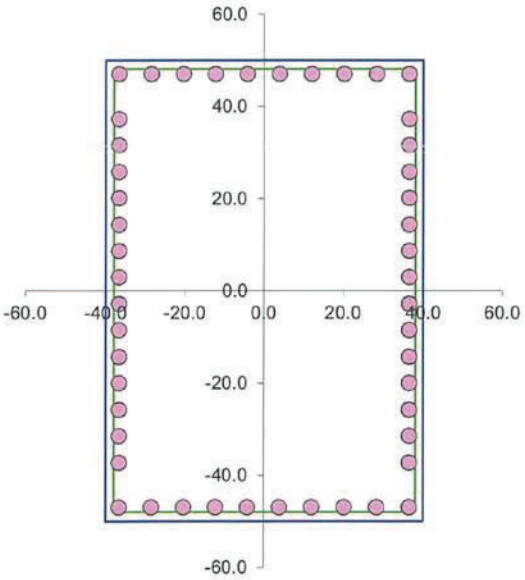
Stirrup DB 12 @ 0.400

Boundary of tie stirrup Column

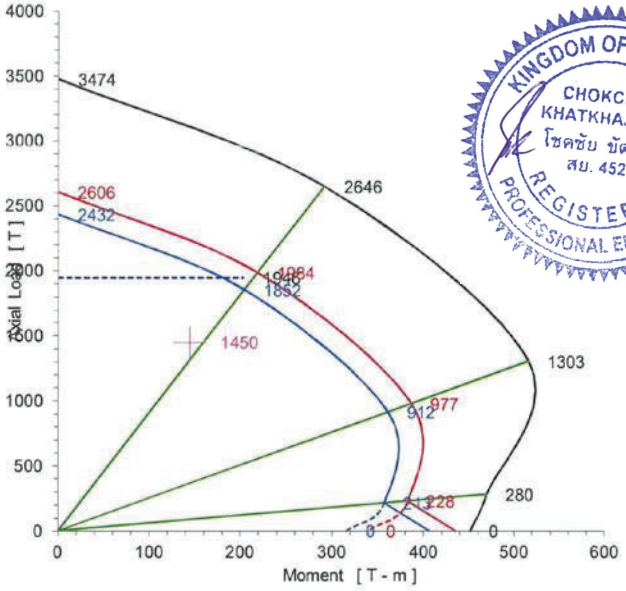
Boundary of sprial stirrup Column

Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



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Column C-1 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-1 4th-5th

Project : อาคารทิศตะวันตก

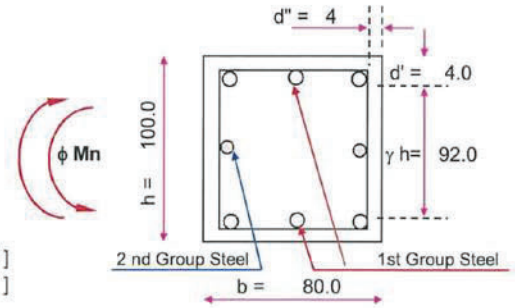
filename : COLUMN

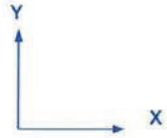
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d''	=	4	[cm]		
Load	ϕ Pn	=	1180	[T]		
Moment	ϕ Mn	=	118	[T-m]		
Separate Steel 2 group	1 st.	=	20	As =	98.2	[cm^2]
	2 nd.	=	28	As =	137.4	[cm^2]
Steel Reinforcement	No.	=	48			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	58.055	[cm]		
	p of Steel	=	0.029	OK		

Main Steel Used 48 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

e b = 0.37 [cm]





Clumn (80 x 100)

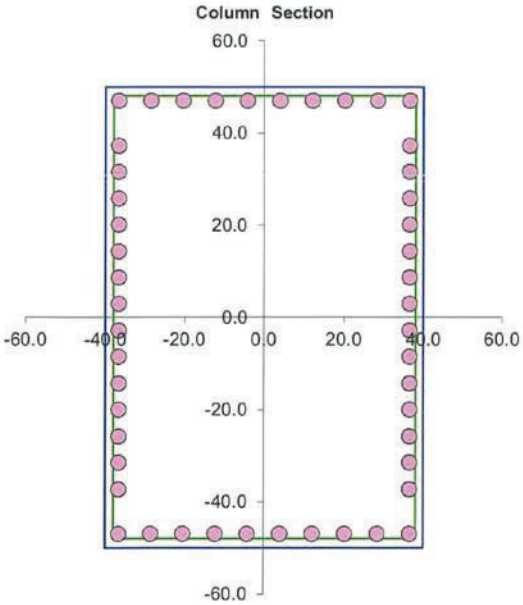
Steel 48 DB 25

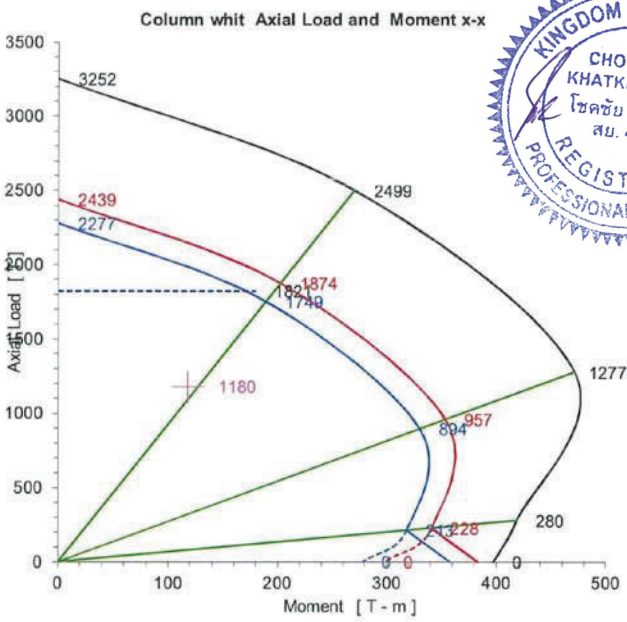
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column

Boundary of sprial stirrup Column

Boundary of Ultimate Capacity





Column C-1 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-1 6th-7th

Project : อาคารทิศตะวันตก

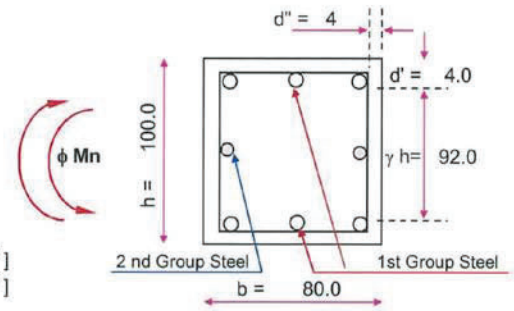
filename : COLUMN

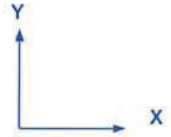
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	910	[T]		
Moment	ϕ Mn	=	91	[T-m]		
Separate Steel 2 group	1 st.	=	16	As =	78.5	[cm^2]
	2 nd.	=	14	As =	68.7	[cm^2]
Steel Reinforcement	No.	=	30			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	**58.055**	[cm]		
	ρ of Steel	=	0.018	OK		

Main Steel Used 30 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

e b = 0.36 [cm]





Clumn (80 x 100)

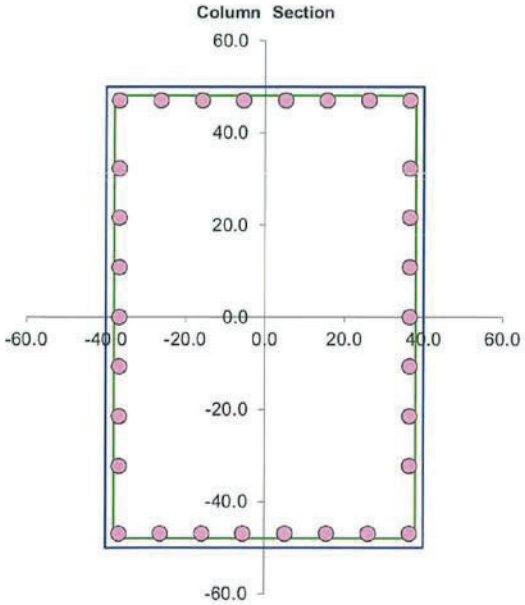
Steel 30 DB 25

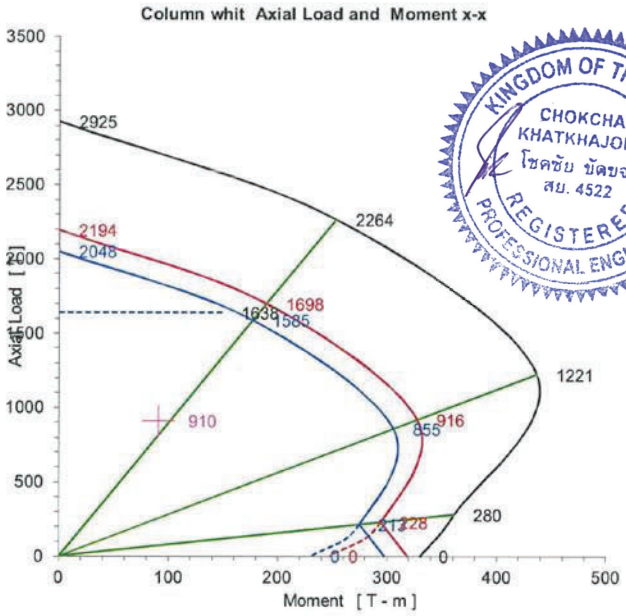
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column

Boundary of sprial stirrup Column

Boundary of Ultimate Capacity





KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-1 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-1 8th-Roof

Project : อาคารทิศตะวันตก

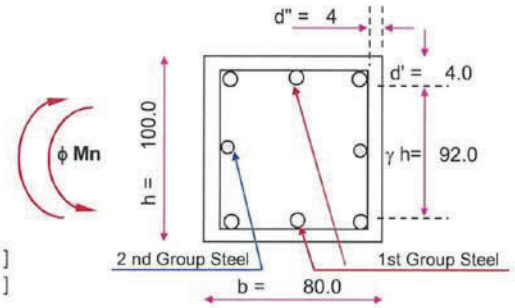
filename : COLUMN

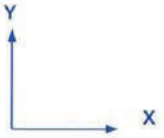
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	640	[T]		
Moment	ϕ Mn	=	64	[T-m]		
Separate Steel 2 group	1 st.	=	10	As =	49.1	[cm^2]
	2 nd.	=	14	As =	68.7	[cm^2]
Steel Reinforcement	No.	=	24			
	d	=	96	[cm]		
d (εu / (εy + εu))	Cb	=	58.055	[cm]		
	p of Steel	=	0.015	OK		

Main Steel Used 24 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

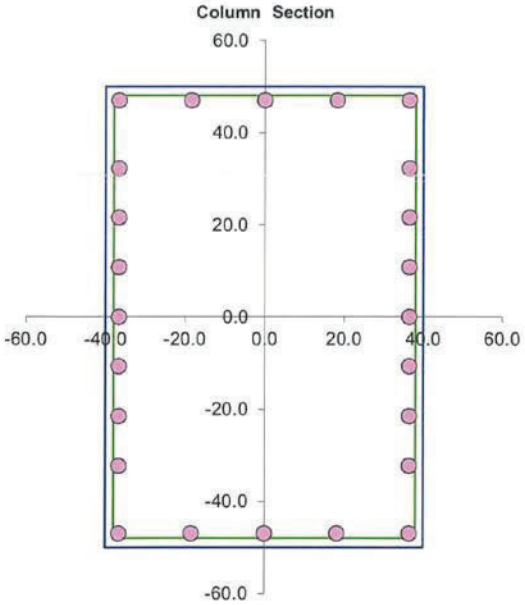
e b = 0.31 [cm]

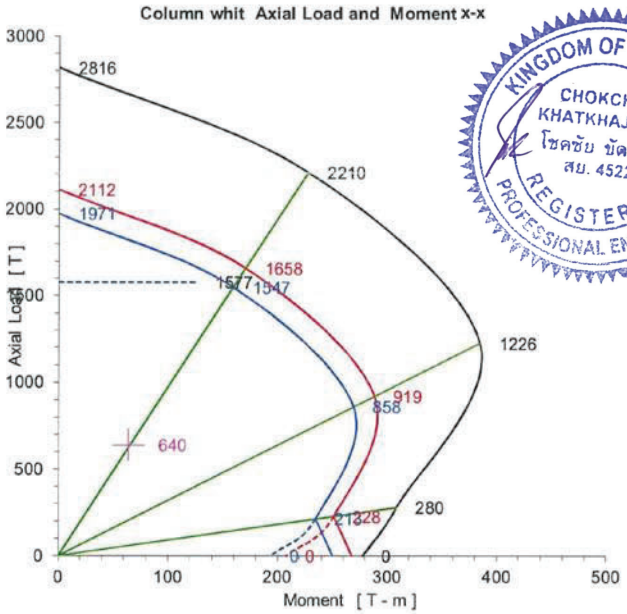




Clumn (80 x 100)
Steel 24 DB 25
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity





Column C-1 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-1A 1st

Project : อาคารทิศตะวันตก

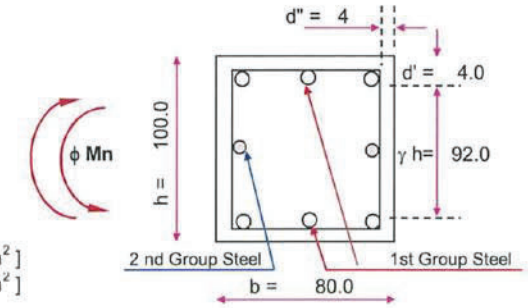
filename : COLUMN

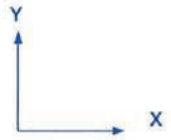
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	1250	[T]		
Moment	ϕ Mn	=	125	[T-m]		
Separate Steel 2 group	1 st.	=	20	As =	123.2	[cm^2]
	2 nd.	=	14	As =	86.2	[cm^2]
Steel Reinforcement	No.	=	34			
	d	=	96	[cm]		
d (εu / (εy + εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.026	OK		

Main Steel Used 34 DB 28 — DB 28

Stirrup DB 12 @ 0.400 — DB 12

e b = 0.42 [cm]





Clumn (80 x 100)

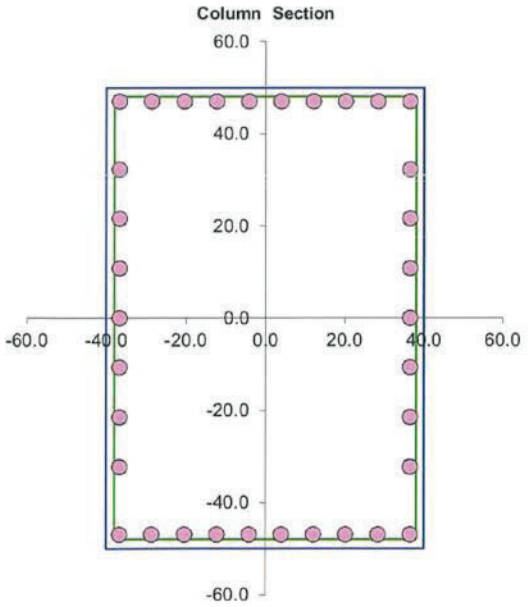
Steel 34 DB 28

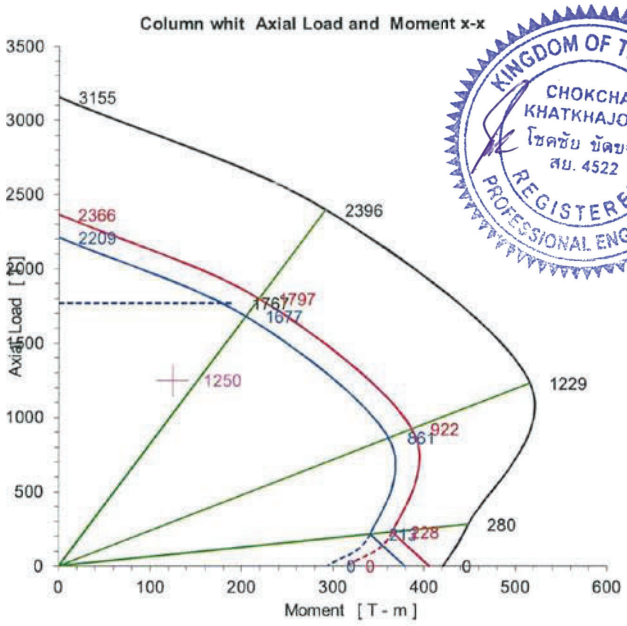
Stirrup DB 12 @ 0.400

Boundary of tie stirrup Column

Boundary of sprial stirrup Column

Boundary of Ultimate Capacity





Column C-1A (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-1A 2nd-3rd

Project : อาคารทิศตะวันตก

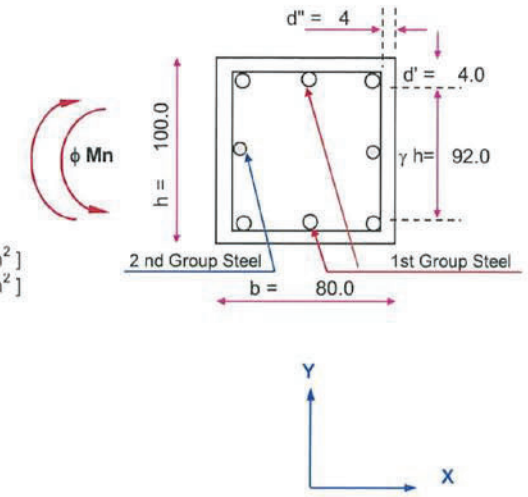
filename : COLUMN

Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	1145	[T]		
Moment	ϕ Mn	=	115	[T-m]		
Separate Steel 2 group	1 st.	=	20	As =	123.2	[cm^2]
	2 nd.	=	10	As =	61.6	[cm^2]
Steel Reinforcement	No.	=	30			
	d	=	96	[cm]		
d (εu / (εy + εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.023	OK		

Main Steel Used 30 DB 28 — DB 28

Stirrup DB 12 @ 0.400 — DB 12

e b = 0.43 [cm]

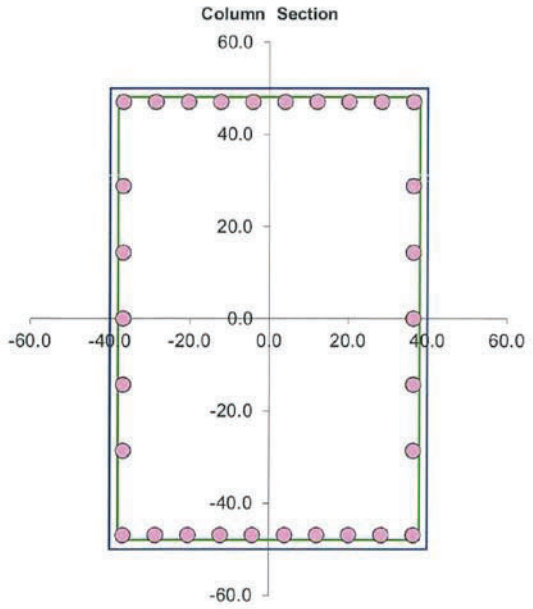


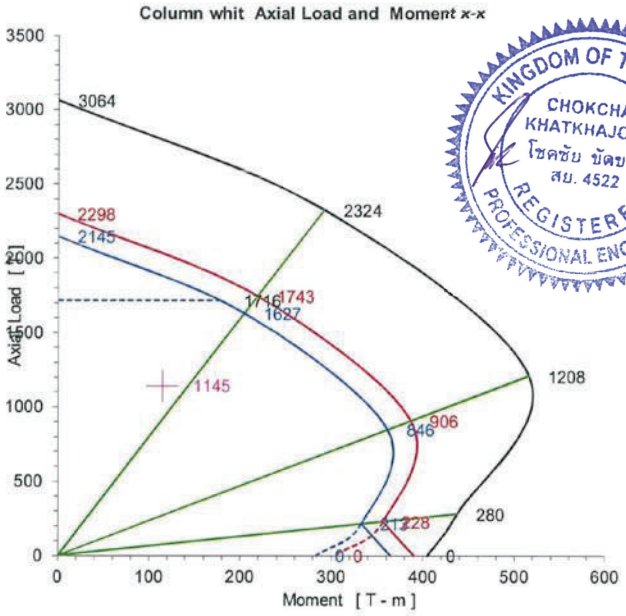
Clumn (80 x 100)

Steel 30 DB 28

Stirrup DB 12 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity





KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-1A (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-1A 4th-5th

Project : อาคารทิศตะวันตก

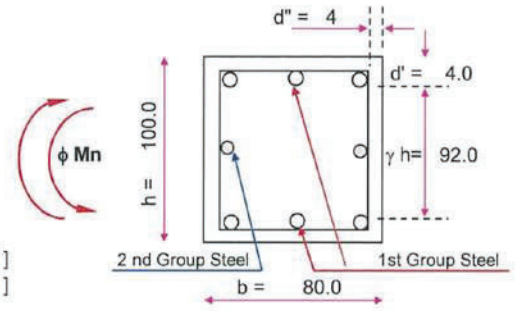
filename : COLUMN

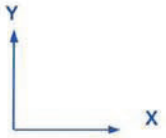
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d''	=	4	[cm]		
Load	ϕ Pn	=	1045	[T]		
Moment	ϕ Mn	=	105	[T-m]		
Separate Steel 2 group	1 st.	=	20	As =	98.2	[cm^2]
	2 nd.	=	10	As =	49.1	[cm^2]
Steel Reinforcement	No.	=	30			
	d	=	96	[cm]		
d (ε u / (ε y + ε u))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.018	OK		

Main Steel Used 30 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

e b = 0.39 [cm]





Clumn (80 x 100)

Steel 30 DB 25

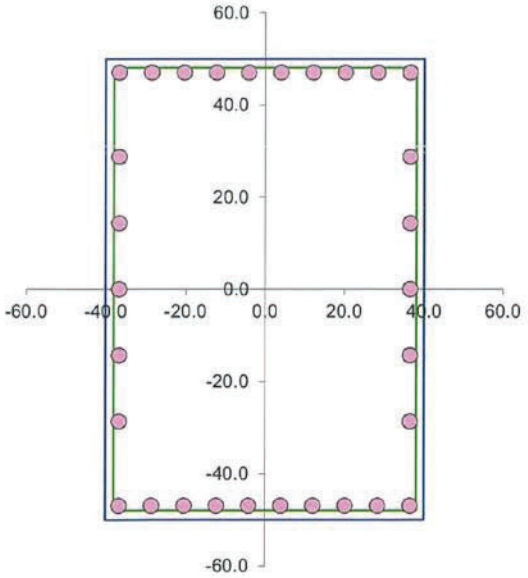
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column

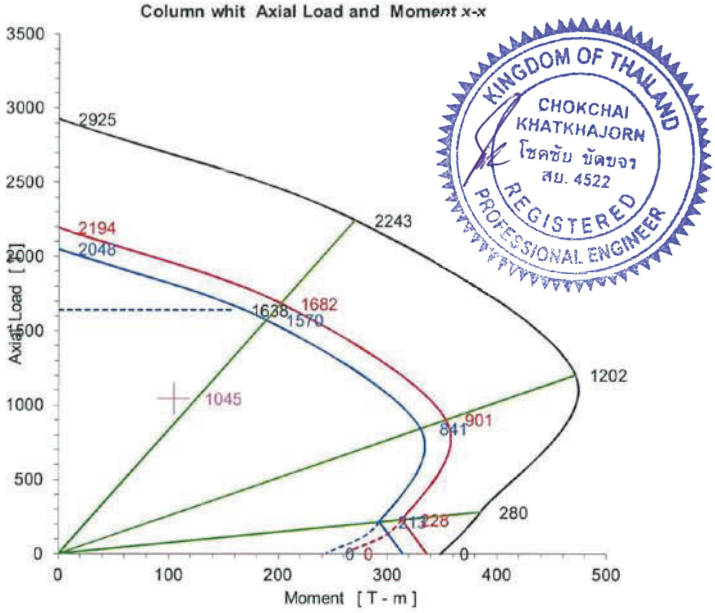
Boundary of sprial stirrup Column

Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column **C-1A** (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-1A 6th-7th

Project : อาคารทิศตะวันตก

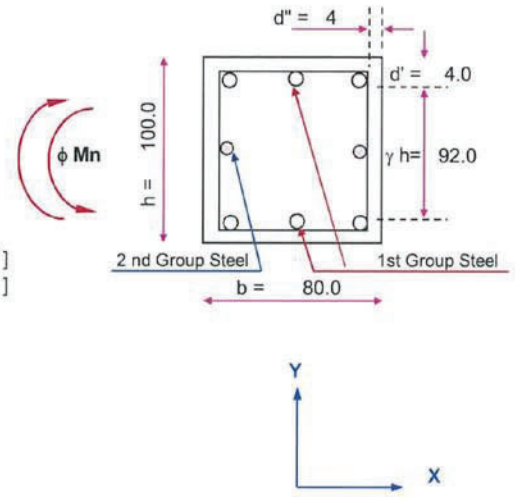
filename : COLUMN

Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	830	[T]		
Moment	ϕ Mn	=	83	[T-m]		
Separate Steel 2 group	1 st.	=	18	As =	88.4	[cm^2]
	2 nd.	=	10	As =	49.1	[cm^2]
Steel Reinforcement	No.	=	28			
	d	=	96	[cm]		
d (εu / (εy + εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.017	OK		

Main Steel Used 28 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

e b = 0.38 [cm]

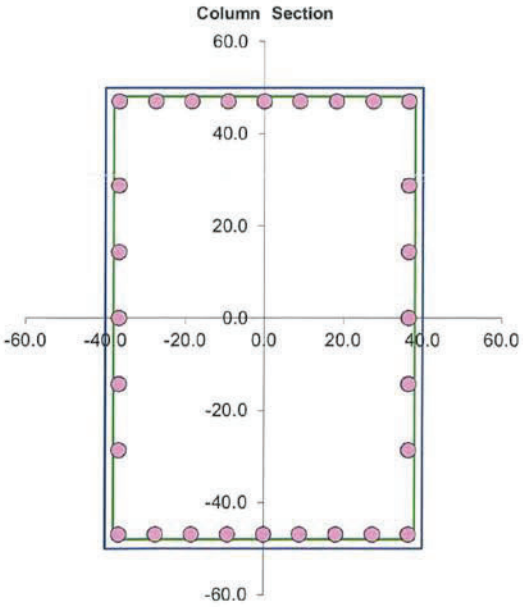


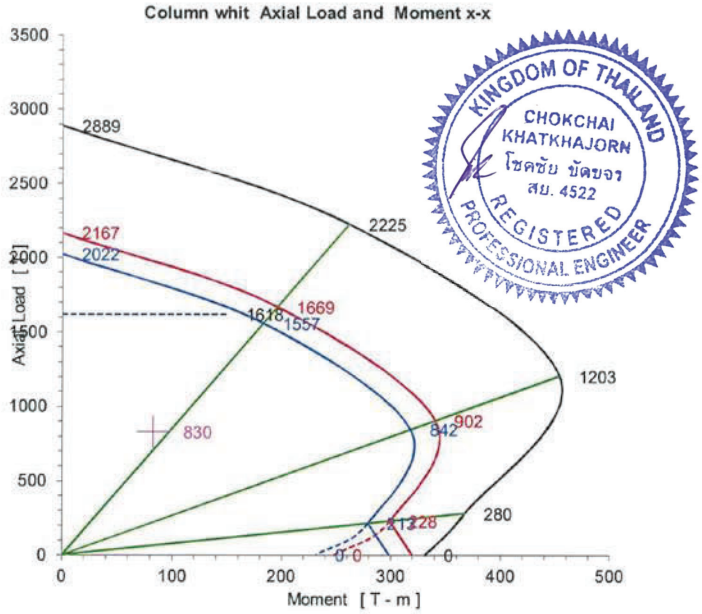
Clumn (80 x 100)

Steel 28 DB 25

Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity





Column C-1A (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-1A 8th-Roof

Project : อาคารทิศตะวันตก

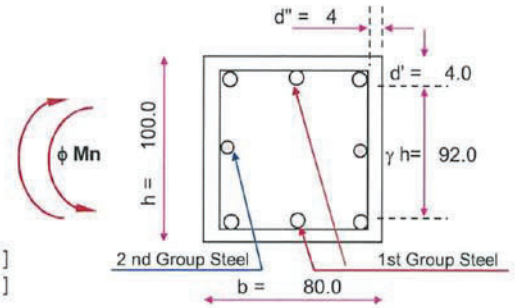
filename : COLUMN

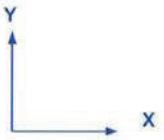
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	518	[T]		
Moment	ϕ Mn	=	52	[T-m]		
Separate Steel 2 group	1 st.	=	14	As =	68.7	[cm^2]
	2 nd.	=	10	As =	49.1	[cm^2]
Steel Reinforcement	No.	=	24			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	58.055	[cm]		
	p of Steel	=	0.015	OK		

Main Steel Used 24 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

e b = 0.35 [cm]





Clumn (80 x 100)

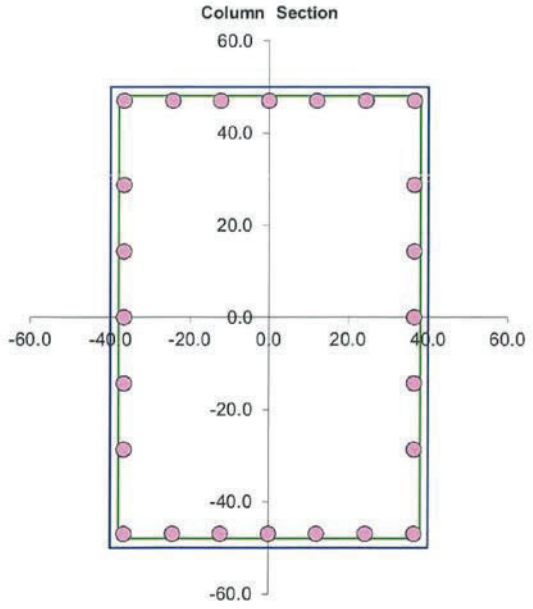
Steel 24 DB 25

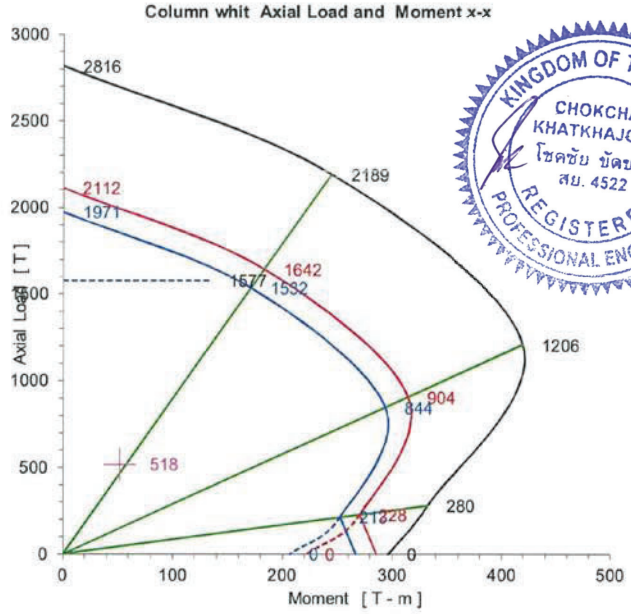
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column

Boundary of sprial stirrup Column

Boundary of Ultimate Capacity





Column C-1A (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318-89)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-2 1st-2nd

Project : อาคารทิศตะวันตก

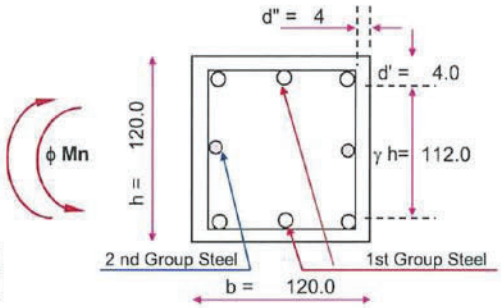
filename : COLUMN

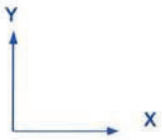
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	120	[cm]		
	h	=	120	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	2867	[T]		
Moment	ϕ Mn	=	286	[T-m]		
Separate Steel 2 group	1 st.	=	28	As =	172.4	[cm^2]
	2 nd.	=	36	As =	221.7	[cm^2]
Steel Reinforcement	No.	=	64			
	d	=	116	[cm]		
d (εu / (εy + εu))	Cb	=	70.150	[cm]		
	ρ of Steel	=	0.027	OK		

Main Steel Used 64 DB 28 — DB 28

Stirrup DB 12 @ 0.400 — DB 12

e b = 0.44 [cm]





Clumn (120 x 120)

Steel 64 DB 28

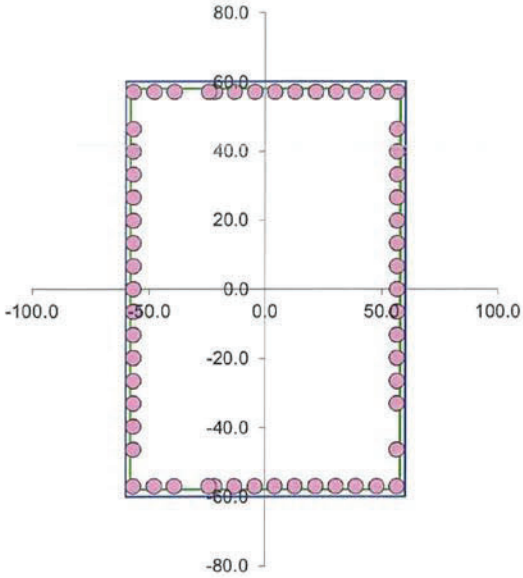
Stirrup DB 12 @ 0.400

Boundary of tie stirrup Column

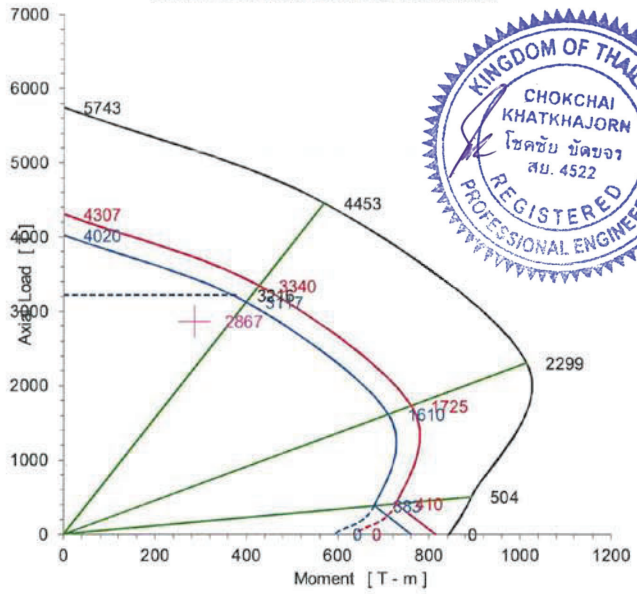
Boundary of sprial stirrup Column

Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



KINGDOM OF THAILAND
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Column **C-2** (120 x 120)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-2 3rd-5th

Project : อาคารทิศตะวันตก

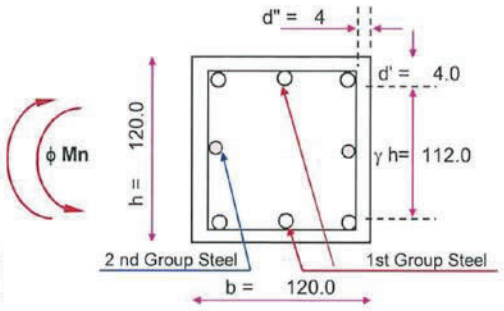
filename : COLUMN

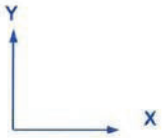
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	120	[cm]		
	h	=	120	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	2712	[T]		
Moment	ϕ Mn	=	271	[T-m]		
Separate Steel 2 group	1 st.	=	28	As =	172.4	[cm^2]
	2 nd.	=	28	As =	172.4	[cm^2]
Steel Reinforcement	No.	=	56			
	d	=	116	[cm]		
d (εu / (εy + εu))	Cb	=	70.150	[cm]		
	ρ of Steel	=	0.024	OK		

Main Steel Used 56 DB 28 — DB 28

Stirrup DB 12 @ 0.400 — DB 12

e b = 0.45 [cm]

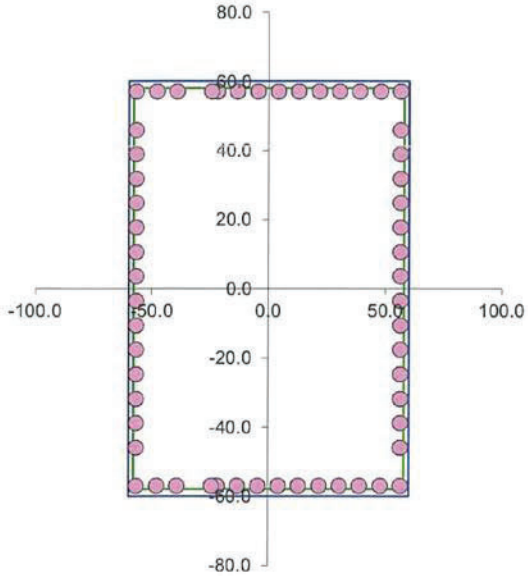




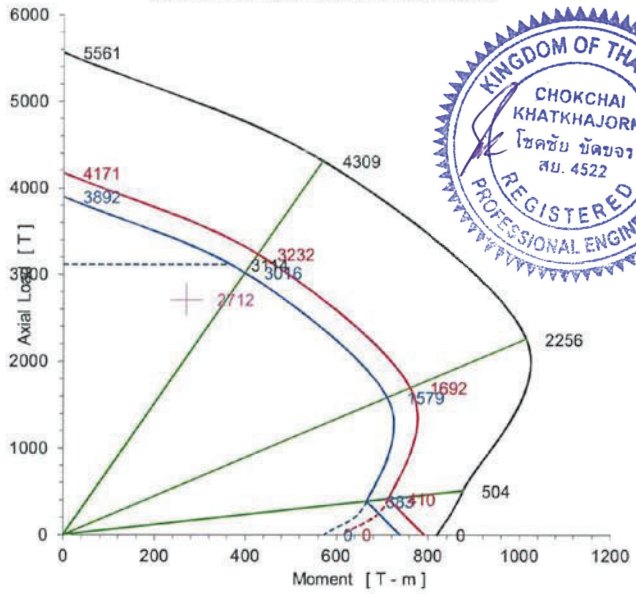
Clumn (120 x 120)
Steel 56 DB 28
Stirrup DB 12 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



KINGDOM OF THAILAND
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สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-2 (120 x 120)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-2 4th-5th

Project : อาคารทิศตะวันตก

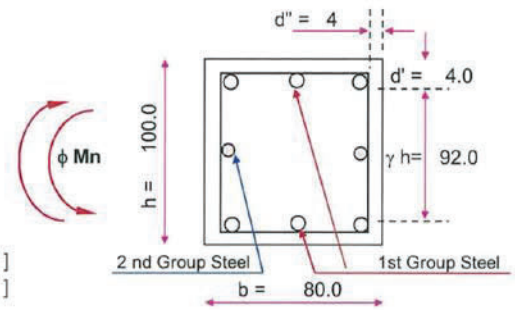
filename : COLUMN

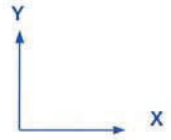
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	1200	[T]		
Moment	ϕ Mn	=	120	[T-m]		
Separate Steel 2 group	1 st.	=	20	As =	98.2	[cm^2]
	2 nd.	=	36	As =	176.7	[cm^2]
Steel Reinforcement	No.	=	56			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.034	OK		

Main Steel Used 56 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

e b = 0.36 [cm]



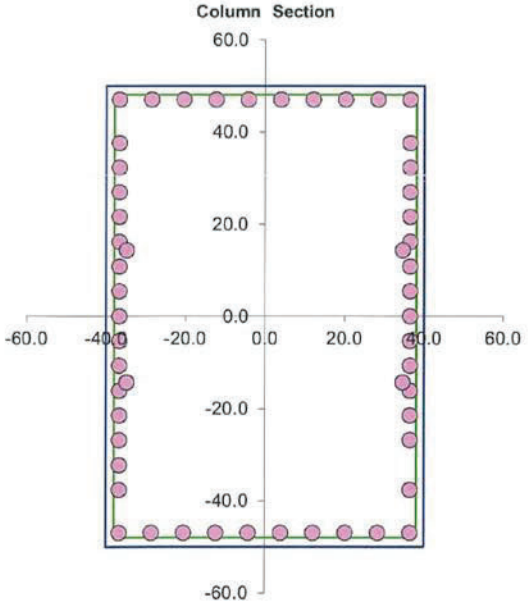


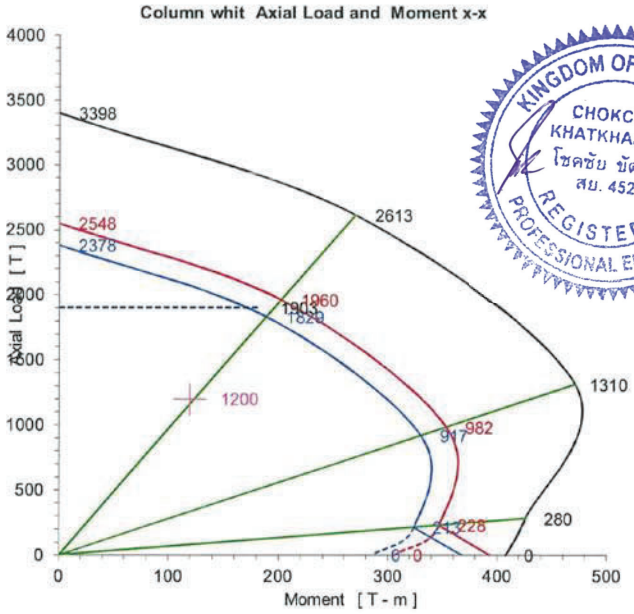
Clumn (80 x 100)

Steel 56 DB 25

Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity





KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
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สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-2 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-2 6th-7th

Project : อาคารทิศตะวันตก

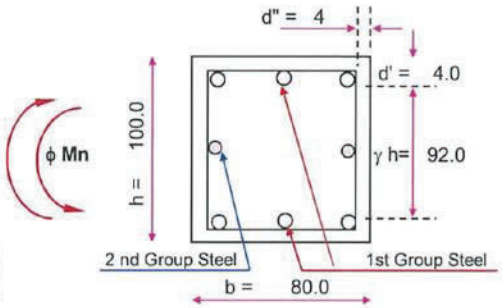
filename : COLUMN

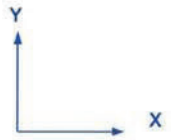
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	930	[T]		
Moment	ϕ Mn	=	93	[T-m]		
Separate Steel 2 group	1 st.	=	16	As =	78.5	[cm^2]
	2 nd.	=	14	As =	68.7	[cm^2]
Steel Reinforcement	No.	=	30			
	d	=	96	[cm]		
d (εu / (εy + εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.018	OK		

Main Steel Used 30 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

e b = 0.36 [cm]





Clumn (80 x 100)

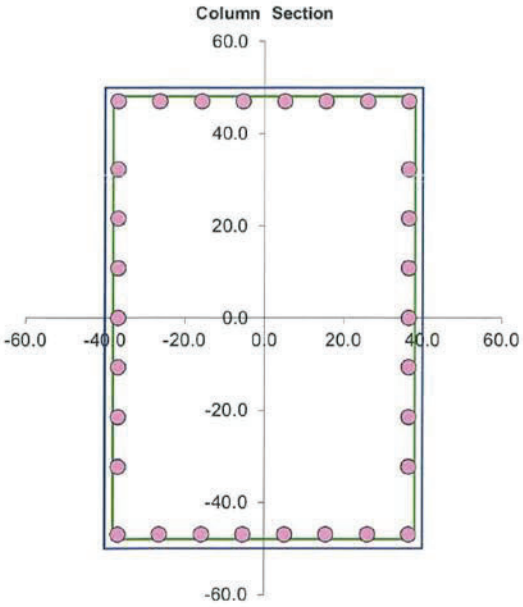
Steel 30 DB 25

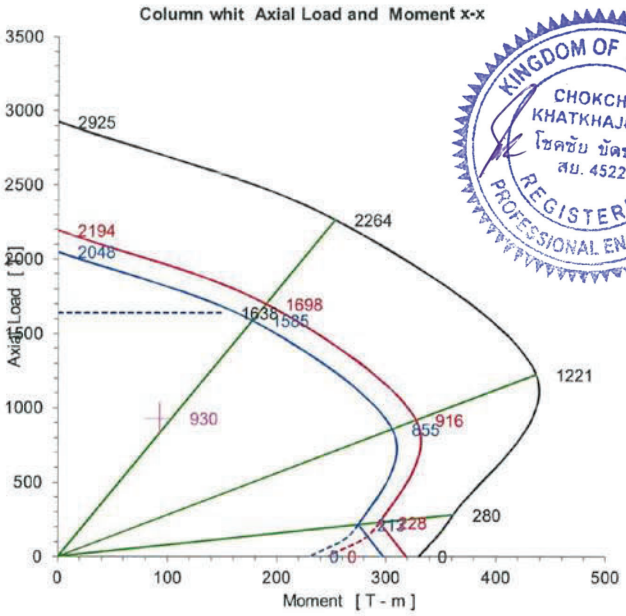
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column

Boundary of sprial stirrup Column

Boundary of Ultimate Capacity





Column C-2 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

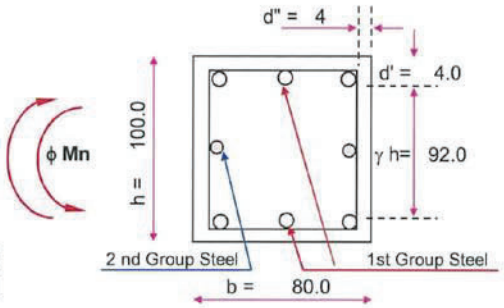
Column Whit Axial Force and Moment X - X
(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-2 8th-Roof
Project : อาคารทิศตะวันตก
filename : COLUMN

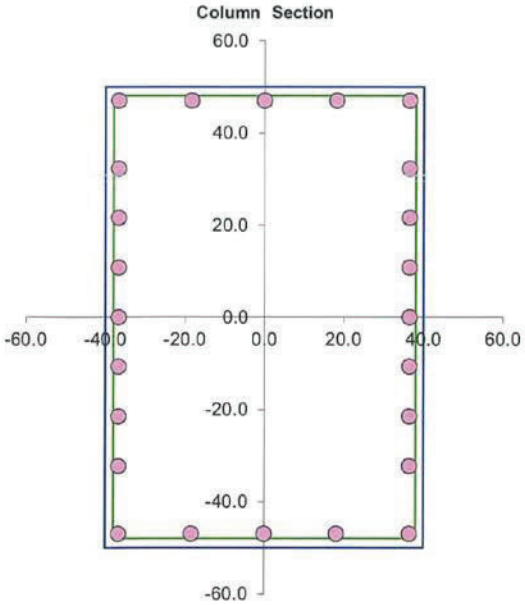
Concrete Strength	fc'	=	350	[kg/cm^2]	
	fy SD	=	4000	[kg/cm^2]	
	fy RD	=	2400	[kg/cm^2]	
Column Dimension	b	=	80	[cm]	
	h	=	100	[cm]	
	d'	=	4	[cm]	
	d"	=	4	[cm]	
Load	ϕ Pn	=	660	[T]	
Moment	ϕ Mn	=	66	[T-m]	
Separate Steel 2 group	1 st.	=	10	As = 49.1	[cm^2]
	2 nd.	=	14	As = 68.7	[cm^2]
Steel Reinforcement	No.	=	24		
	d	=	96	[cm]	
d (εu / (εy + εu))	Cb	=	58.055	[cm]	
	ρ of Steel	=	0.015	OK	

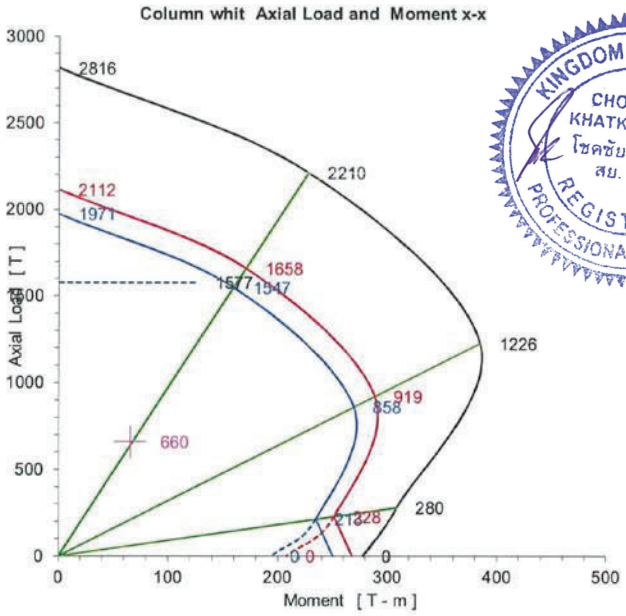
Main Steel Used 24 DB 25 — DB 25
Stirrup RB 9 @ 0.400 — RB 9
e b = 0.31 [cm]



Clumn (80 x 100)
Steel 24 DB 25
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity





Column C-2 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-3 1st

Project : อาคารทิศตะวันตก

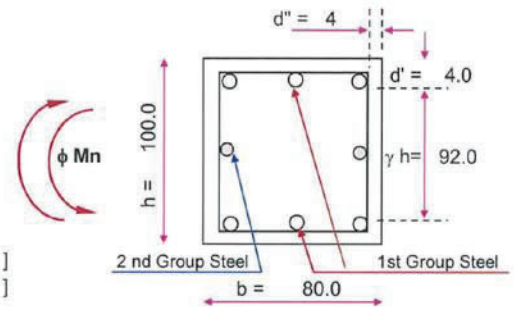
filename : COLUMN

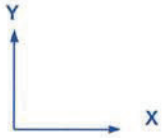
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	1605	[T]		
Moment	ϕ Mn	=	160	[T-m]		
Separate Steel 2 group	1 st.	=	26	As =	160.1	[cm^2]
	2 nd.	=	36	As =	221.7	[cm^2]
Steel Reinforcement	No.	=	62			
	d	=	96	[cm]		
d (εu / (εy + εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.048	OK		

Main Steel Used 62 DB 28 — DB 28

Stirrup DB 12 @ 0.400 — DB 12

e b = 0.43 [cm]

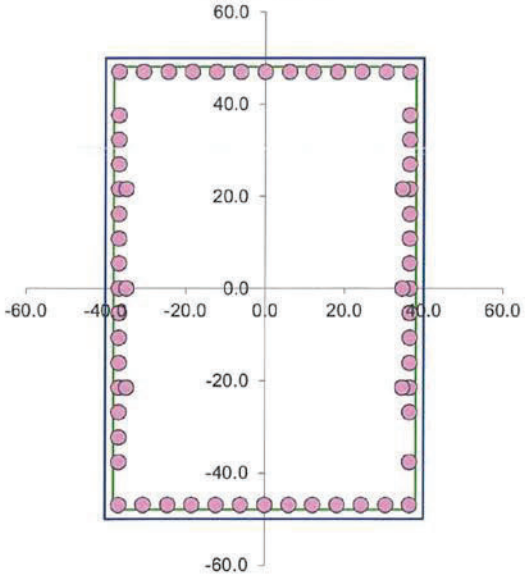




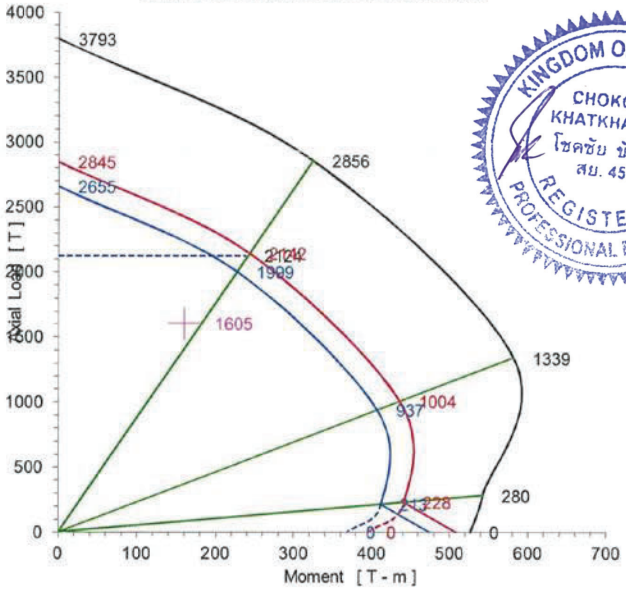
Clumn (80 x 100)
Steel 62 DB 28
Stirrup DB 12 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-3 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-3 2nd-3rd

Project : อาคารทิศตะวันตก

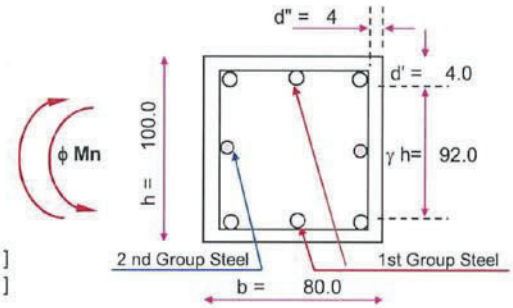
filename : COLUMN

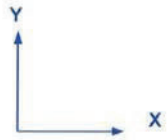
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	1470	[T]		
Moment	ϕ Mn	=	147	[T-m]		
Separate Steel 2 group	1 st.	=	20	As =	123.2	[cm^2]
	2 nd.	=	36	As =	221.7	[cm^2]
Steel Reinforcement	No.	=	56			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.043	OK		

Main Steel Used 56 DB 28 — DB 28

Stirrup DB 12 @ 0.400 — DB 12

e b = 0.38 [cm]





Clumn (80 x 100)

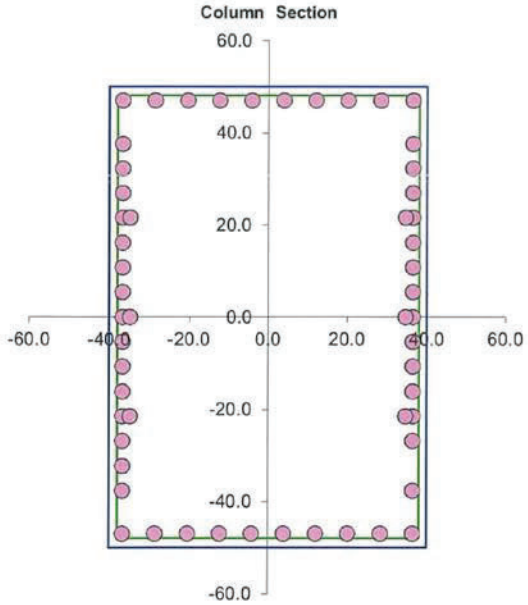
Steel 56 DB 28

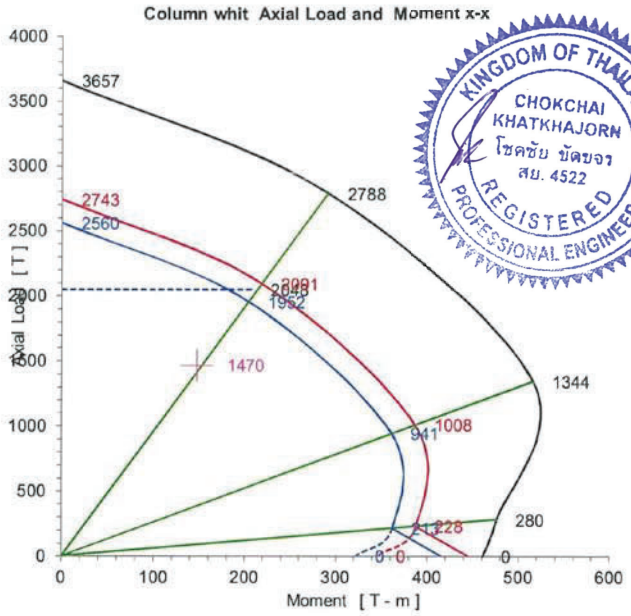
Stirrup DB 12 @ 0.400

Boundary of tie stirrup Column

Boundary of sprial stirrup Column

Boundary of Ultimate Capacity





Column C-3 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-3 4h-5th

Project : อาคารทิศตะวันตก

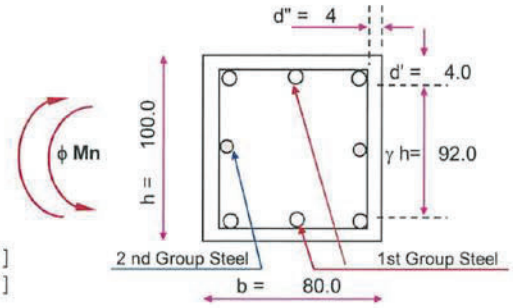
filename : COLUMN

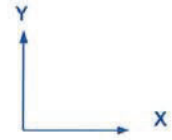
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	1200	[T]		
Moment	ϕ Mn	=	120	[T-m]		
Separate Steel 2 group	1 st.	=	20	As =	98.2	[cm^2]
	2 nd.	=	36	As =	176.7	[cm^2]
Steel Reinforcement	No.	=	56			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	58.055	[cm]		
	p of Steel	=	0.034	OK		

Main Steel Used 56 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

e b = 0.36 [cm]





Clumn (80 x 100)

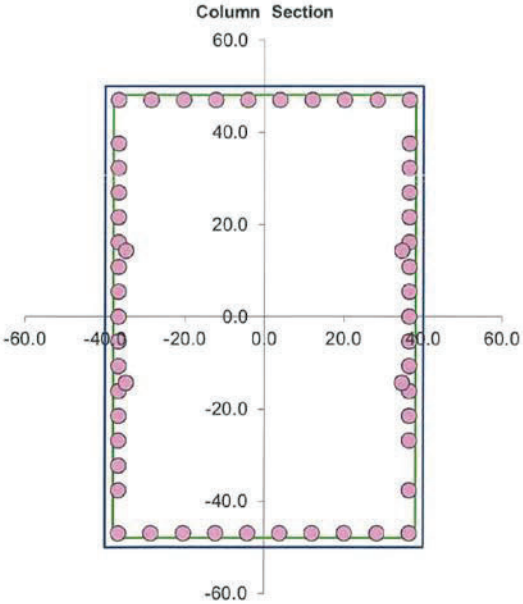
Steel 56 DB 25

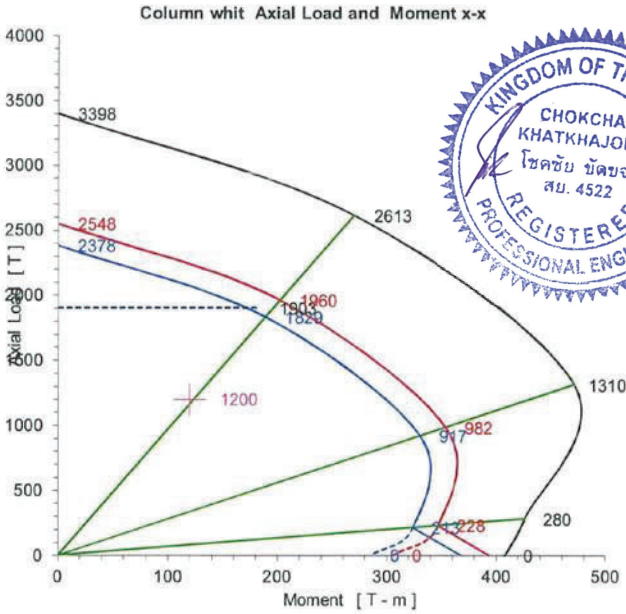
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column

Boundary of sprial stirrup Column

Boundary of Ultimate Capacity





KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-3 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-3 6th-7th

Project : อาคารทิศตะวันตก

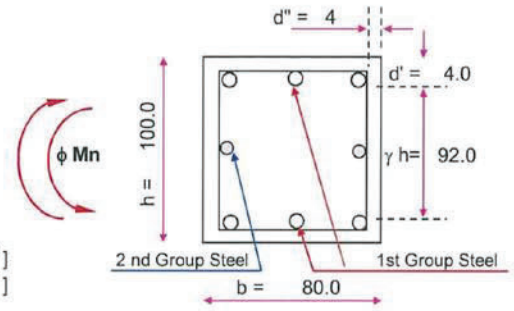
filename : COLUMN

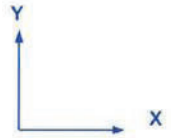
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d''	=	4	[cm]		
Load	ϕ Pn	=	930	[T]		
Moment	ϕ Mn	=	93	[T-m]		
Separate Steel 2 group	1 st.	=	16	As =	78.5	[cm^2]
	2 nd.	=	14	As =	68.7	[cm^2]
Steel Reinforcement	No.	=	30			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.018	OK		

Main Steel Used 30 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

e b = 0.36 [cm]





Clumn (80 x 100)

Steel 30 DB 25

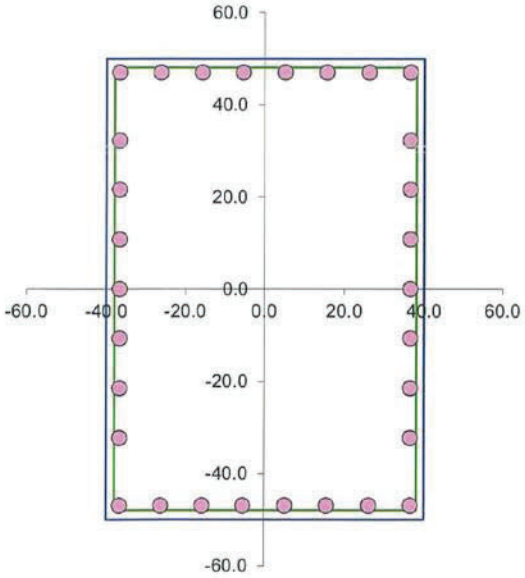
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column

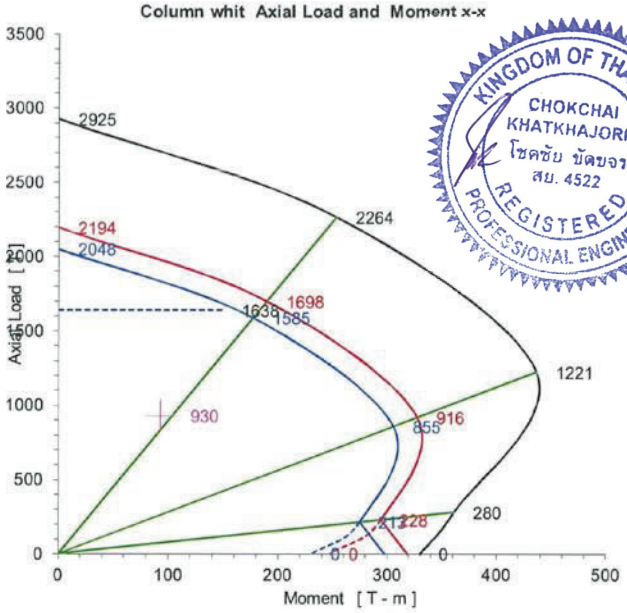
Boundary of sprial stirrup Column

Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-3 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-3 8th-Roof

Project : อาคารทิศตะวันตก

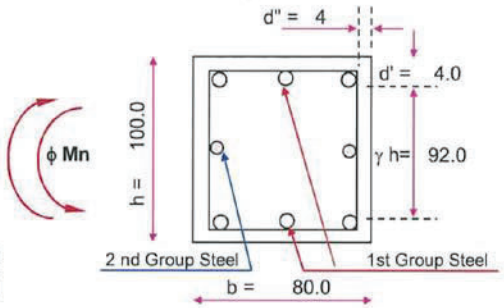
filename : COLUMN

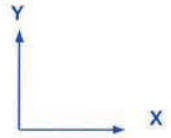
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d''	=	4	[cm]		
Load	ϕ Pn	=	660	[T]		
Moment	ϕ Mn	=	66	[T-m]		
Separate Steel 2 group	1 st.	=	10	As =	49.1	[cm^2]
	2 nd.	=	14	As =	68.7	[cm^2]
Steel Reinforcement	No.	=	24			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	58.055	[cm]		
	p of Steel	=	0.015	OK		

Main Steel Used 24 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

e b = 0.31 [cm]



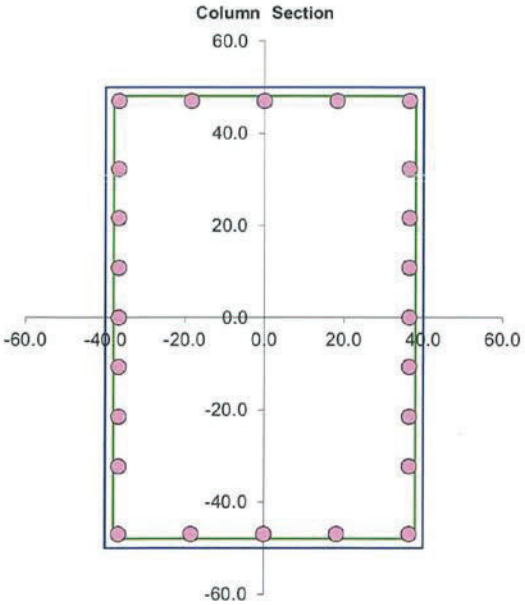


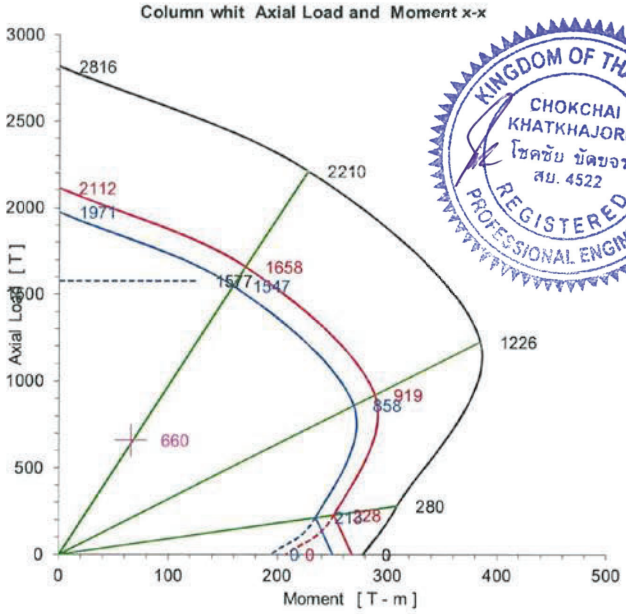
Clumn (80 x 100)

Steel 24 DB 25

Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity





Column C-3 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-4 1st

Project : อาคารทิศตะวันตก

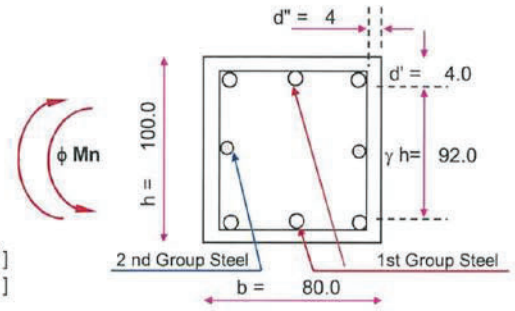
filename : COLUMN

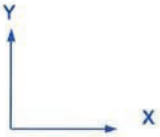
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	1600	[T]		
Moment	ϕ Mn	=	160	[T-m]		
Separate Steel 2 group	1 st.	=	26	As =	160.1	[cm^2]
	2 nd.	=	36	As =	221.7	[cm^2]
Steel Reinforcement	No.	=	62			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.048	OK		

Main Steel Used 62 DB 28 — DB 28

Stirrup DB 12 @ 0.400 — DB 12

e b = 0.43 [cm]





Clumn (80 x 100)

Steel 62 DB 28

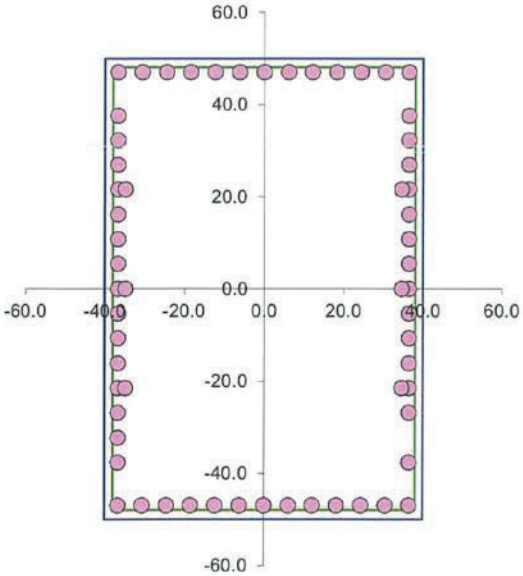
Stirrup DB 12 @ 0.400

Boundary of tie stirrup Column

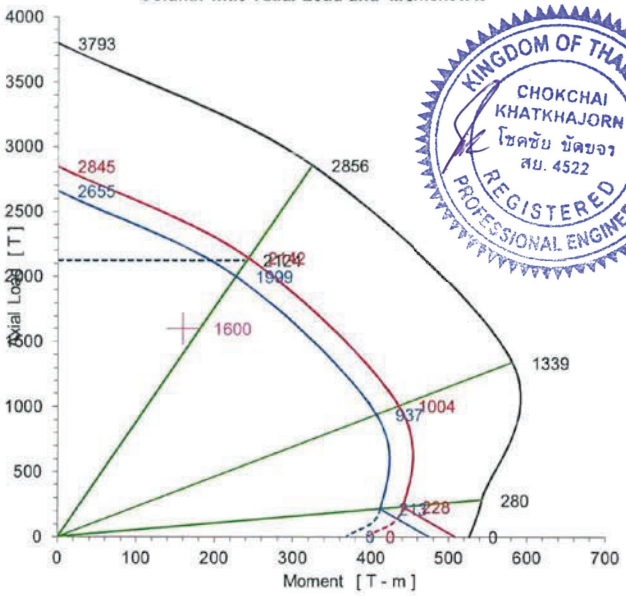
Boundary of sprial stirrup Column

Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



Column **C-4** (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-4 2nd-3rd

Project : อาคารทิศตะวันตก

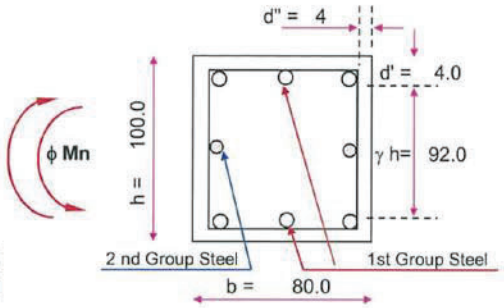
filename : COLUMN

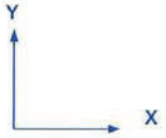
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	1470	[T]		
Moment	ϕ Mn	=	147	[T-m]		
Separate Steel 2 group	1 st.	=	20	As =	123.2	[cm^2]
	2 nd.	=	32	As =	197.0	[cm^2]
Steel Reinforcement	No.	=	52			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.040	OK		

Main Steel Used 52 DB 28 — DB 28

Stirrup DB 12 @ 0.400 — DB 12

e b = 0.39 [cm]

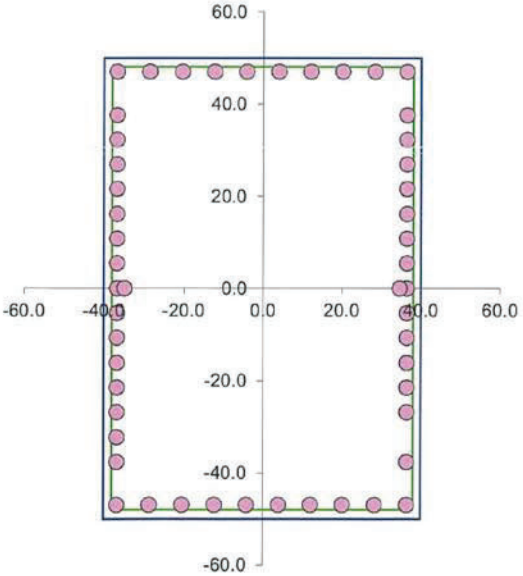




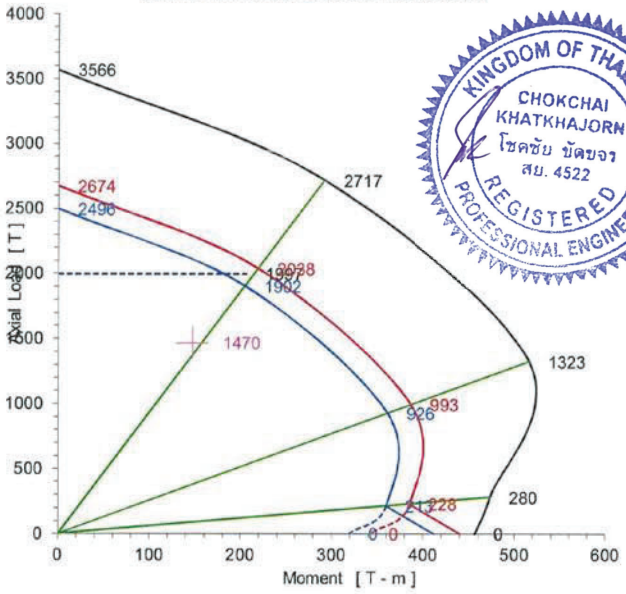
Clumn (80 x 100)
Steel 52 DB 28
Stirrup DB 12 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



Column C-4 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-4 4th-5th

Project : อาคารทิศตะวันตก

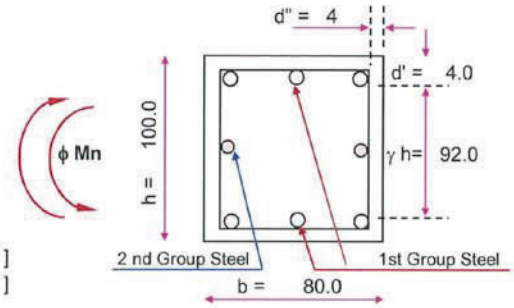
filename : COLUMN

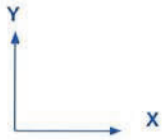
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	1200	[T]		
Moment	ϕ Mn	=	120	[T-m]		
Separate Steel 2 group	1 st.	=	20	As =	98.2	[cm^2]
	2 nd.	=	32	As =	157.1	[cm^2]
Steel Reinforcement	No.	=	52			
	d	=	96	[cm]		
d (ε u / (ε y + ε u))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.032	OK		

Main Steel Used 52 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

e b = 0.36 [cm]





Clumn (80 x 100)

Steel 52 DB 25

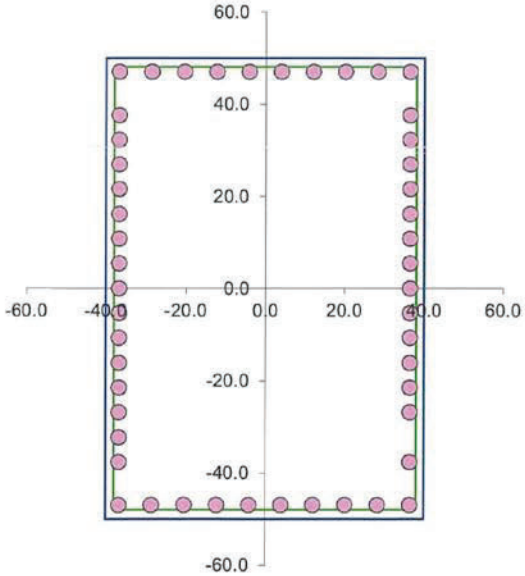
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column

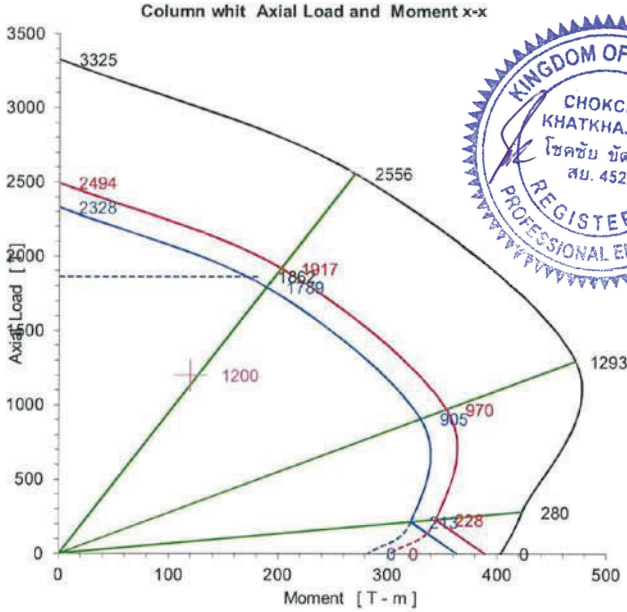
Boundary of sprial stirrup Column

Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-4 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-4 6th-7th

Project : อาคารทิศตะวันตก

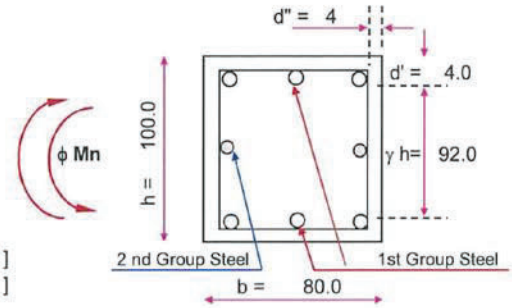
filename : COLUMN

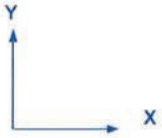
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	930	[T]		
Moment	ϕ Mn	=	93	[T-m]		
Separate Steel 2 group	1 st.	=	18	As =	88.4	[cm^2]
	2 nd.	=	12	As =	58.9	[cm^2]
Steel Reinforcement	No.	=	30			
	d	=	96	[cm]		
d (εu / (εy + εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.018	OK		

Main Steel Used 30 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

e b = 0.37 [cm]





Clumn (80 x 100)

Steel 30 DB 25

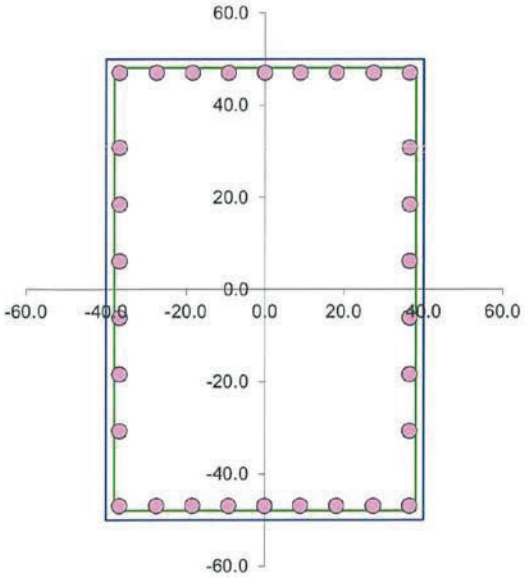
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column

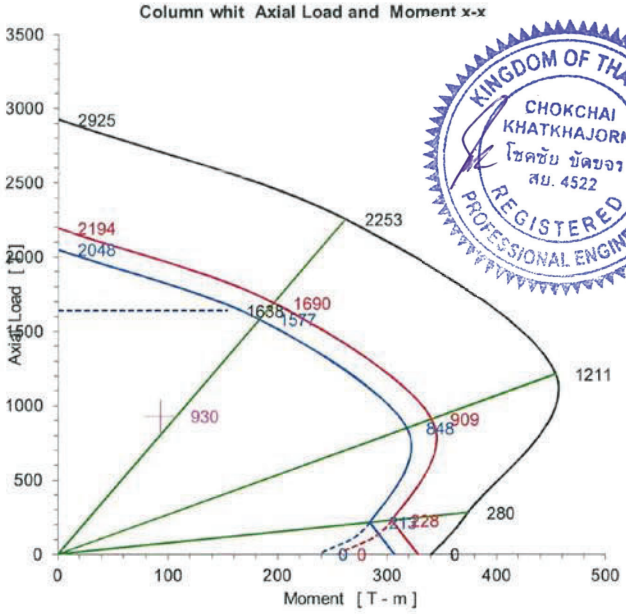
Boundary of sprial stirrup Column

Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column **C-4** (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318-89)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-4 8th-Roof

Project : อาคารทิศตะวันตก

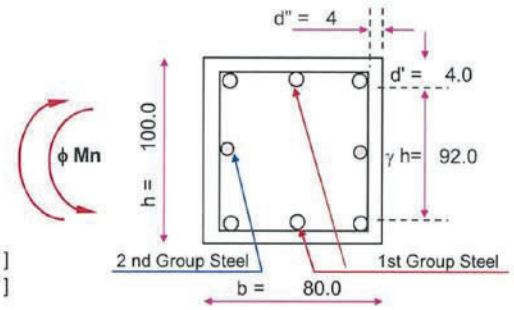
filename : COLUMN

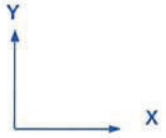
Concrete Strength	fc'	=	350		[kg/cm^2]
	fy SD	=	4000		[kg/cm^2]
	fy RD	=	2400		[kg/cm^2]
Column Dimension	b	=	80		[cm]
	h	=	100		[cm]
	d'	=	4		[cm]
	d"	=	4		[cm]
Load	ϕ Pn	=	660		[T]
Moment	ϕ Mn	=	66		[T-m]
Separate Steel 2 group	1 st.	=	10	As = 49.1	[cm^2]
	2 nd.	=	14	As = 68.7	[cm^2]
Steel Reinforcement	No.	=	24		
	d	=	96		[cm]
d (εu / (εy + εu))	Cb	=	58.055		[cm]
	ρ of Steel	=	0.015	OK	

Main Steel Used 24 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

e b = 0.31 [cm]

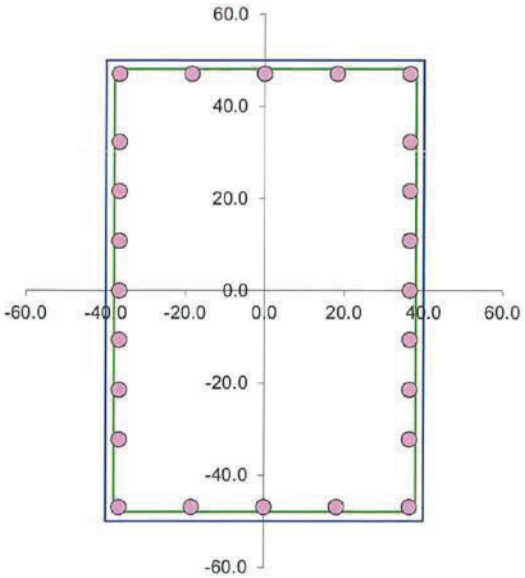




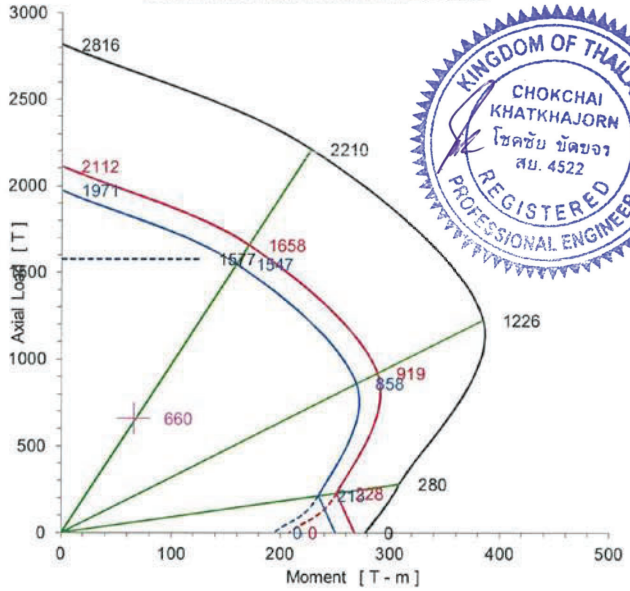
Clumn (80 x 100)
Steel 24 DB 25
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



Column C-4 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-5 1st

Project : อาคารทิศตะวันตก

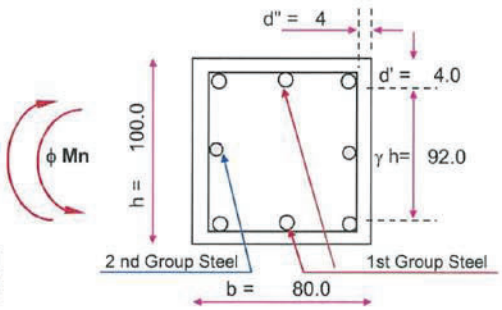
filename : COLUMN

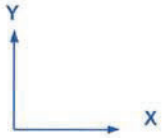
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	330	[T]		
Moment	ϕ Mn	=	33	[T-m]		
Separate Steel 2 group	1 st.	=	14	As =	68.7	[cm^2]
	2 nd.	=	6	As =	29.5	[cm^2]
Steel Reinforcement	No.	=	20			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.012	OK		

Main Steel Used 20 DB 25 — DB 25

Stirrup DB 12 @ 0.400 — DB 12

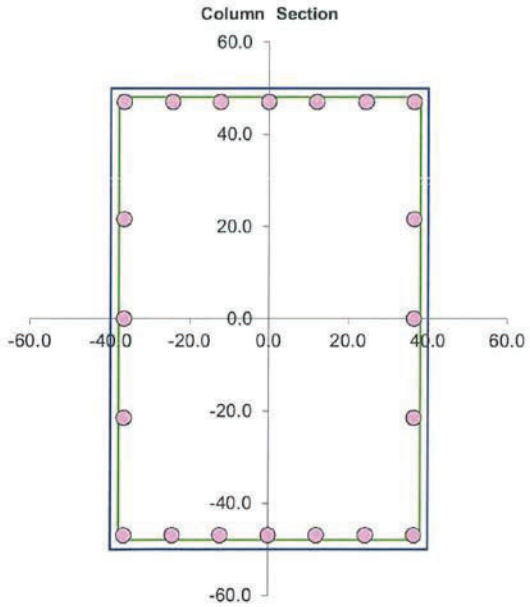
e b = 0.35 [cm]

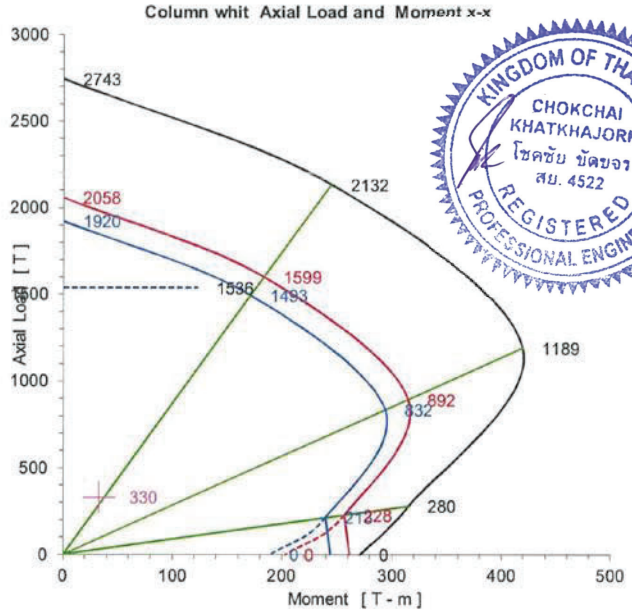




Clumn (80 x 100)
Steel 20 DB 25
Stirrup DB 12 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity





KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-5 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-5 2nd-3rd

Project : อาคารทิศตะวันตก

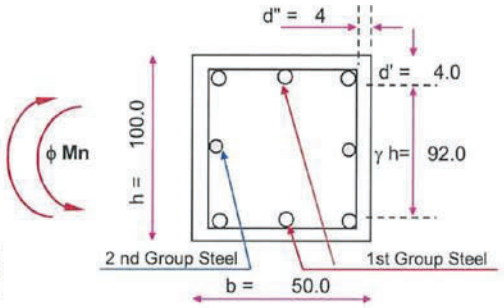
filename : COLUMN

Concrete Strength	fc'	=	350	[kg/cm^2]	
	fy SD	=	4000	[kg/cm^2]	
	fy RD	=	2400	[kg/cm^2]	
Column Dimension	b	=	50	[cm]	
	h	=	100	[cm]	
	d'	=	4	[cm]	
	d"	=	4	[cm]	
Load	ϕ Pn	=	165	[T]	
Moment	ϕ Mn	=	16	[T-m]	
Separate Steel 2 group	1 st.	=	14	As = 68.7	[cm^2]
	2 nd.	=	6	As = 29.5	[cm^2]
Steel Reinforcement	No.	=	20		
	d	=	96	[cm]	
d (εu/(εy+εu))	Cb	=	58.055	[cm]	
	ρ of Steel	=	0.020	OK	

Main Steel Used 20 DB 25 — DB 25

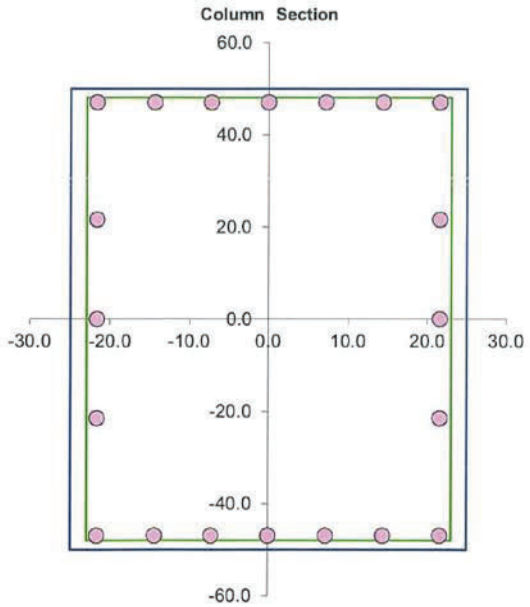
Stirrup DB 12 @ 0.400 — DB 12

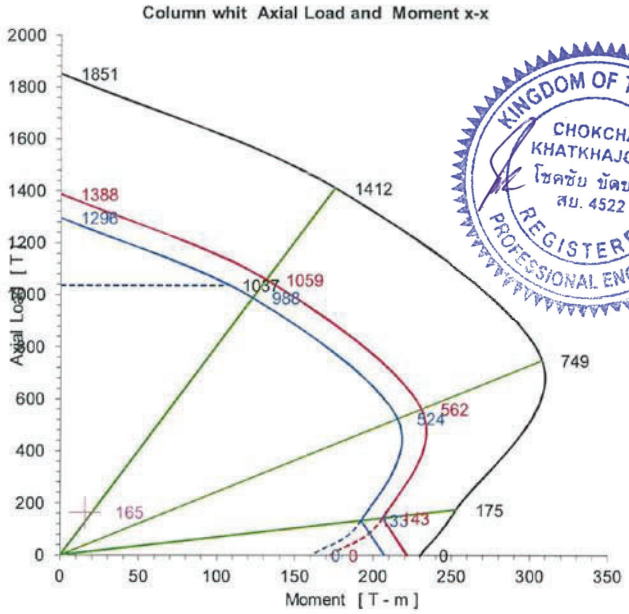
e b = 0.41 [cm]



Clumn (50 x 100)
Steel 20 DB 25
Stirrup DB 12 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity





KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-5 (50 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-6 1st

Project : อาคารทิศตะวันตก

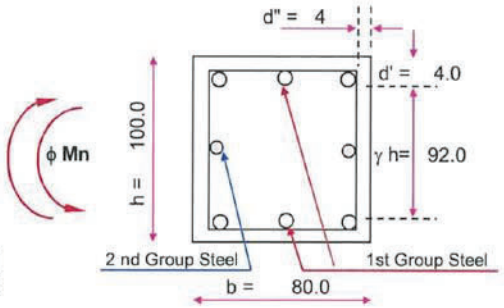
filename : COLUMN

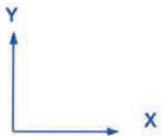
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d''	=	4	[cm]		
Load	ϕ Pn	=	2080	[T]		
Moment	ϕ Mn	=	208	[T-m]		
Separate Steel 2 group	1 st.	=	28	As =	172.4	[cm^2]
	2 nd.	=	48	As =	295.6	[cm^2]
Steel Reinforcement	No.	=	76			
	d	=	96	[cm]		
d (εu / (εy + εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.058	OK		

Main Steel Used 76 DB 28 — DB 28

Stirrup DB 12 @ 0.400 — DB 12

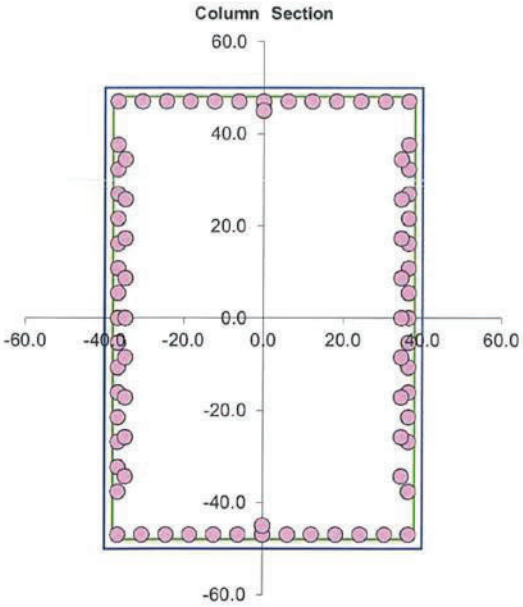
e b = 0.43 [cm]

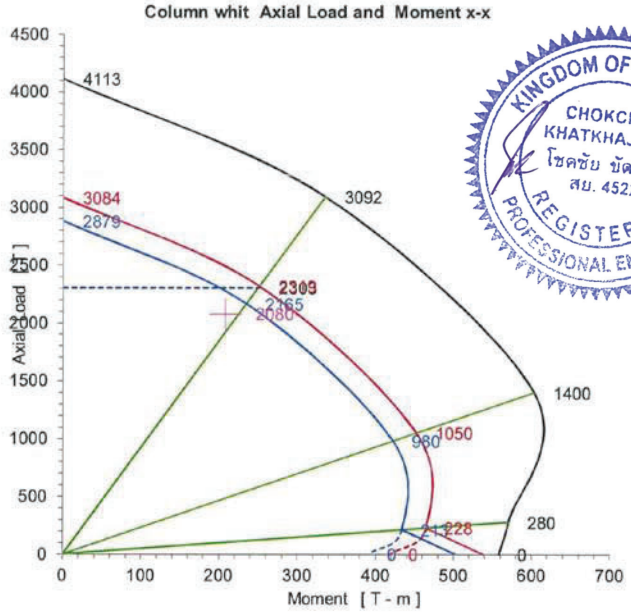




Clumn (80 x 100)
Steel 76 DB 28
Stirrup DB 12 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity





Column C-6 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-6 2nd-3rd

Project : อาคารทิศตะวันตก

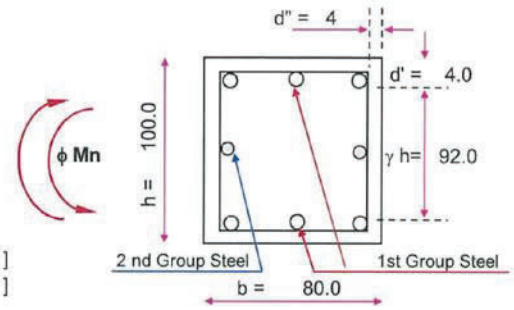
filename : COLUMN

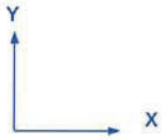
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	1834	[T]		
Moment	ϕ Mn	=	183	[T-m]		
Separate Steel 2 group	1 st.	=	24	As =	147.8	[cm^2]
	2 nd.	=	40	As =	246.3	[cm^2]
Steel Reinforcement	No.	=	64			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.049	OK		

Main Steel Used 64 DB 28 — DB 28

Stirrup DB 12 @ 0.400 — DB 12

e b = 0.41 [cm]

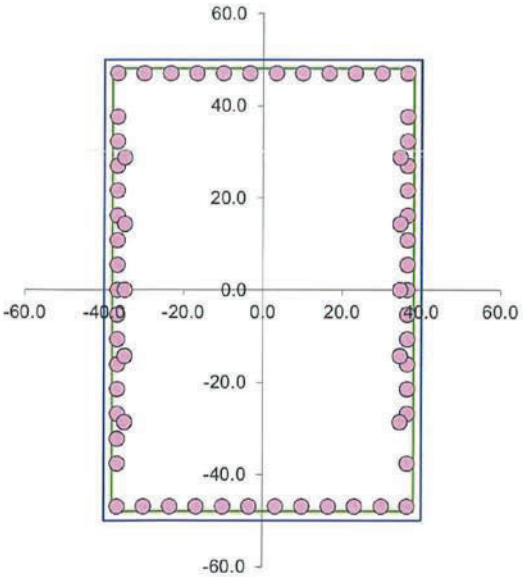




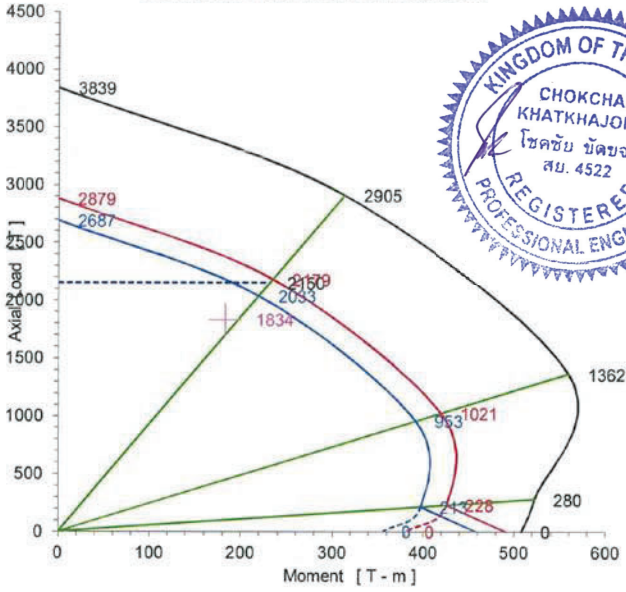
Clumn (80 x 100)
Steel 64 DB 28
Stirrup DB 12 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-6 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-6 4th-5th

Project : อาคารทิศตะวันตก

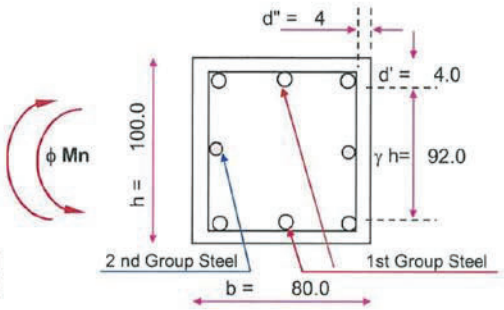
filename : COLUMN

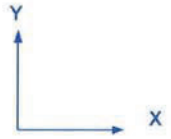
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d''	=	4	[cm]		
Load	ϕ Pn	=	1600	[T]		
Moment	ϕ Mn	=	160	[T-m]		
Separate Steel 2 group	1 st.	=	32	As =	157.1	[cm^2]
	2 nd.	=	28	As =	137.4	[cm^2]
Steel Reinforcement	No.	=	60			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.037	OK		

Main Steel Used 60 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

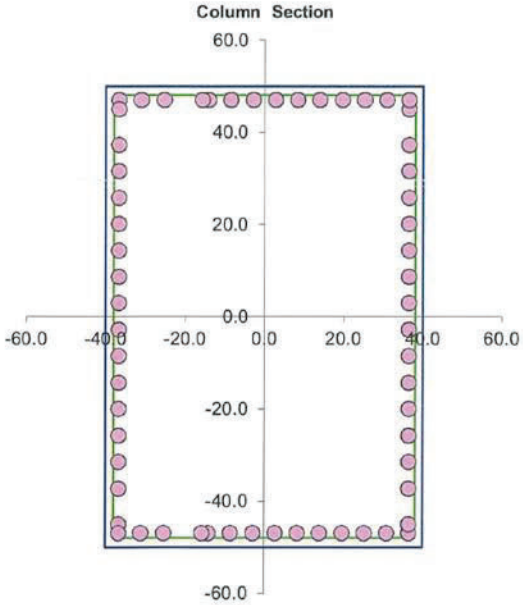
e b = 0.45 [cm]

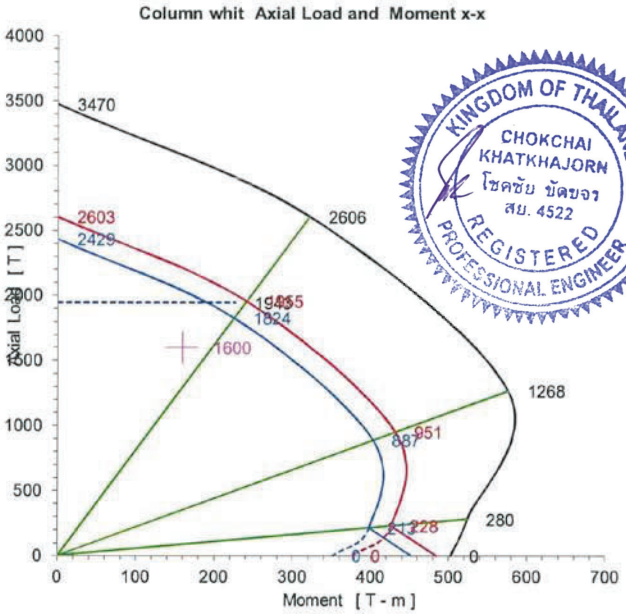




Clumn (80 x 100)
Steel 60 DB 25
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity





KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-6 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-6 6th-7th

Project : อาคารทิศตะวันตก

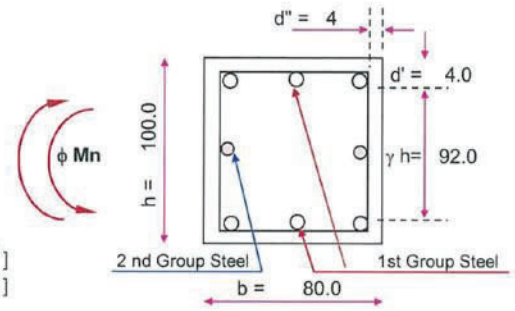
filename : COLUMN

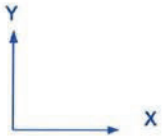
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d''	=	4	[cm]		
Load	ϕ Pn	=	1350	[T]		
Moment	ϕ Mn	=	135	[T-m]		
Separate Steel 2 group	1 st.	=	18	As =	88.4	[cm^2]
	2 nd.	=	30	As =	147.3	[cm^2]
Steel Reinforcement	No.	=	48			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.029	OK		

Main Steel Used 48 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

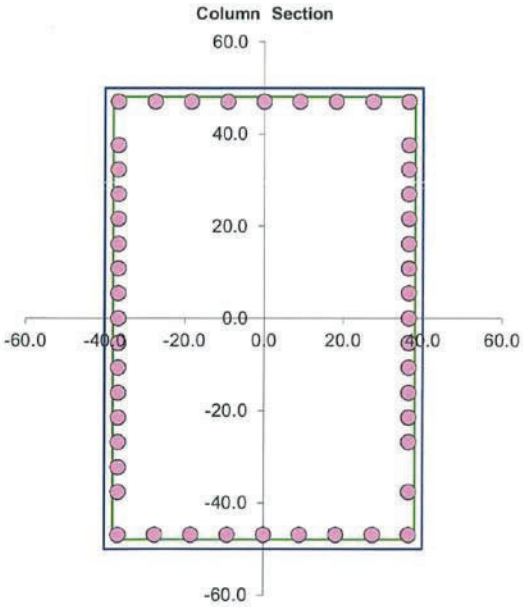
e b = 0.35 [cm]

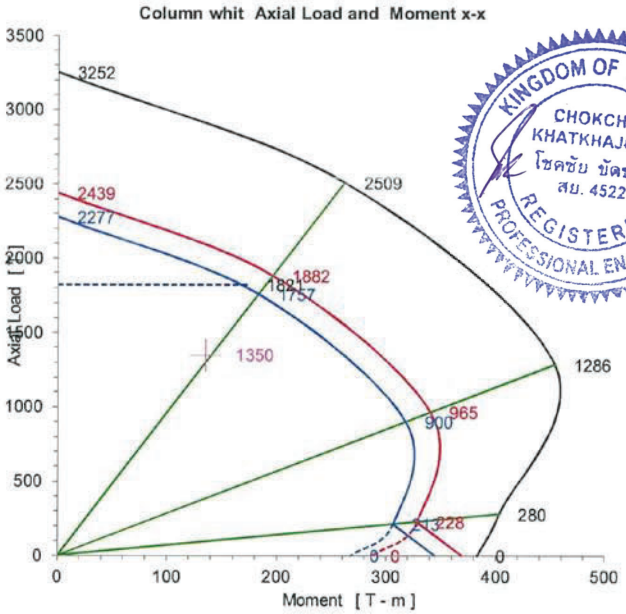




Clumn (80 x 100)
Steel 48 DB 25
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity





KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัตขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-6 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-6 8-Roofth

Project : อาคารทิศตะวันตก

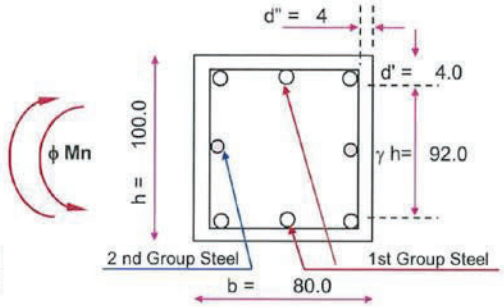
filename : COLUMN

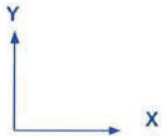
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	1100	[T]		
Moment	ϕ Mn	=	110	[T-m]		
Separate Steel 2 group	1 st.	=	18	As =	88.4	[cm^2]
	2 nd.	=	12	As =	58.9	[cm^2]
Steel Reinforcement	No.	=	30			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.018	OK		

Main Steel Used 30 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

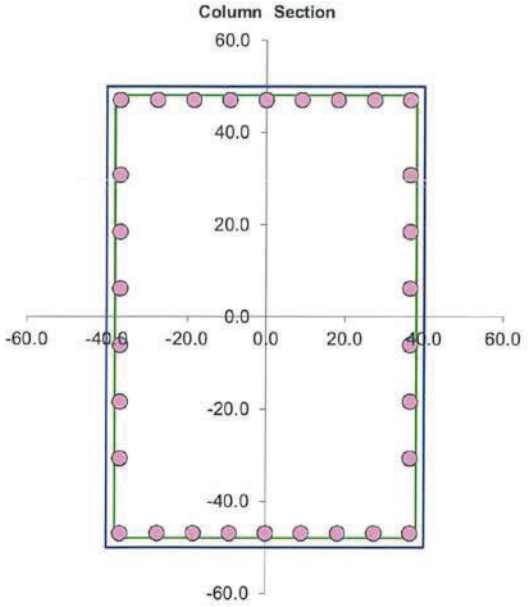
e b = 0.37 [cm]

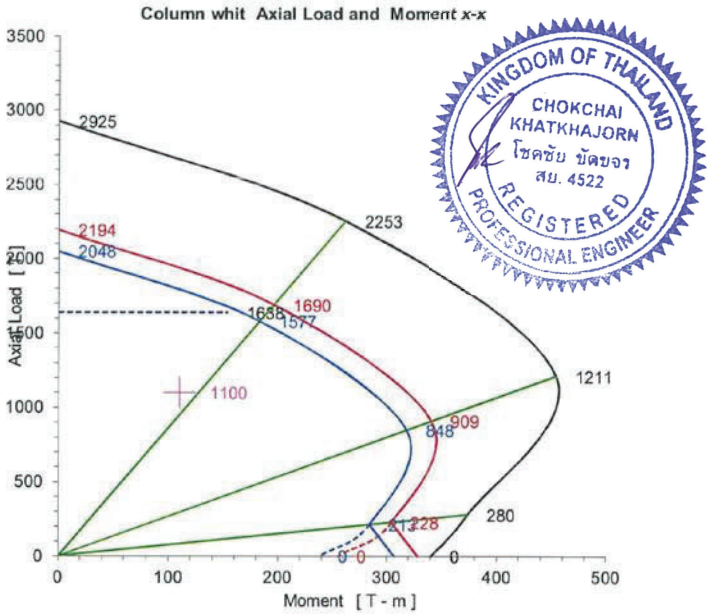




Clumn (80 x 100)
Steel 30 DB 25
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity





KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สบ. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-6 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-9 1st

Project : อาคารทิศตะวันตก

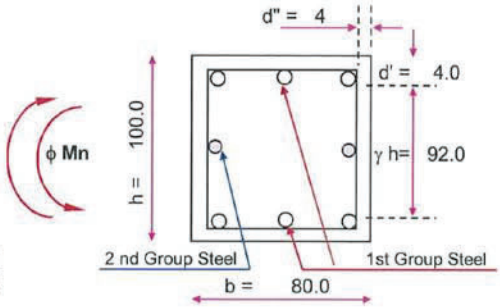
filename : COLUMN

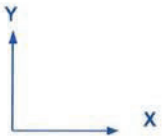
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	330	[T]		
Moment	ϕ Mn	=	33	[T-m]		
Separate Steel 2 group	1 st.	=	10	As =	49.1	[cm^2]
	2 nd.	=	10	As =	49.1	[cm^2]
Steel Reinforcement	No.	=	20			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	58.055	[cm]		
	p of Steel	=	0.012	OK		

Main Steel Used 20 DB 25 — DB 25

Stirrup DB 12 @ 0.400 — DB 12

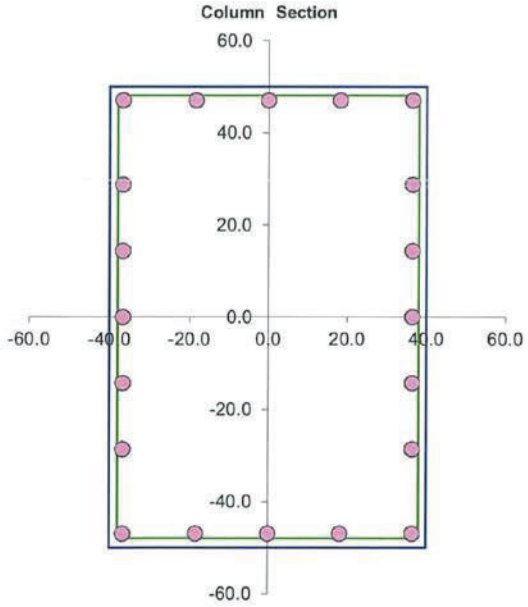
e b = 0.32 [cm]

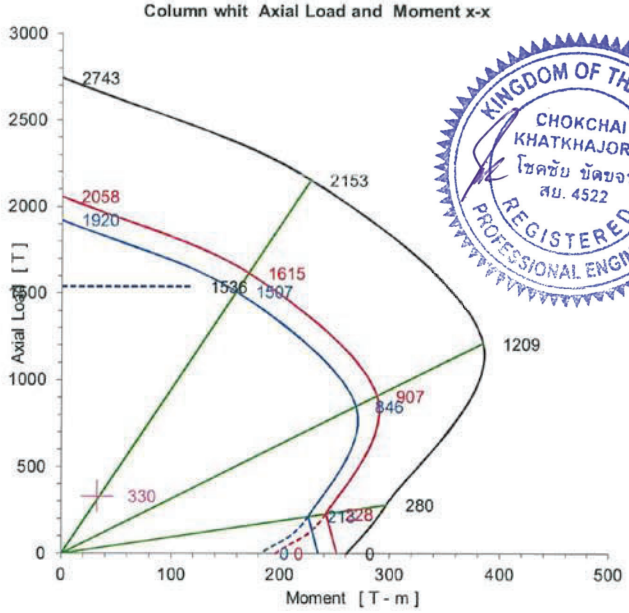




Clumn (80 x 100)
Steel 20 DB 25
Stirrup DB 12 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity





KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สบ. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-9 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-9 2nd-Roof

Project : อาคารทิศตะวันตก

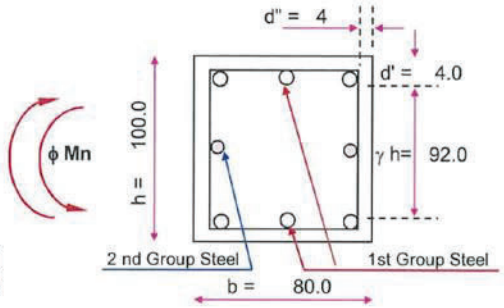
filename : COLUMN

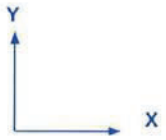
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	80	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	165	[T]		
Moment	ϕ Mn	=	16	[T-m]		
Separate Steel 2 group	1 st.	=	10	As =	49.1	[cm^2]
	2 nd.	=	10	As =	49.1	[cm^2]
Steel Reinforcement	No.	=	20			
	d	=	96	[cm]		
d (εu/(εy+εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.012	OK		

Main Steel Used 20 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

e b = 0.32 [cm]

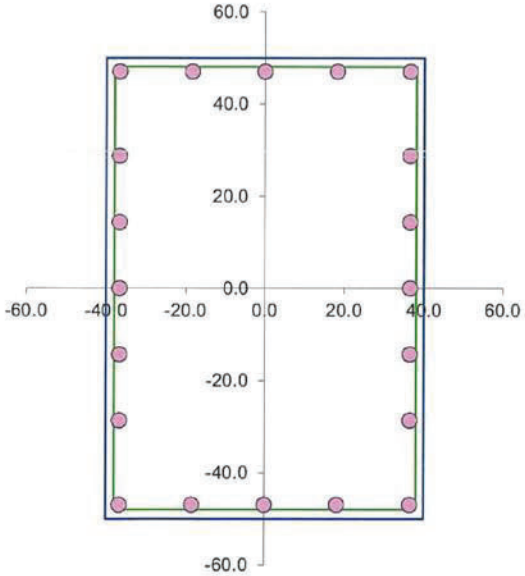




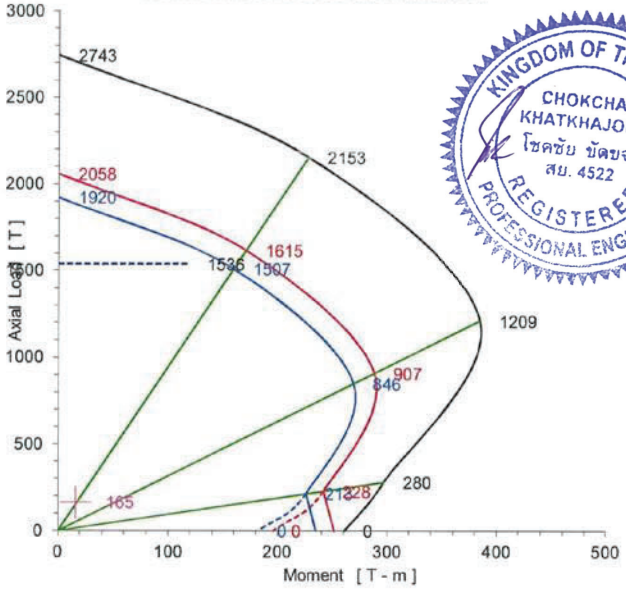
Clumn (80 x 100)
Steel 20 DB 25
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-9 (80 x 100)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-10 1st

Project : อาคารทิศตะวันตก

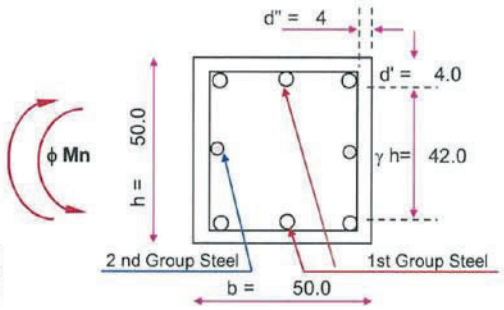
filename : COLUMN

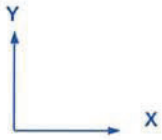
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	50	[cm]		
	h	=	50	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	350	[T]		
Moment	ϕ Mn	=	35	[T-m]		
Separate Steel 2 group	1 st.	=	10	As =	49.1	[cm^2]
	2 nd.	=	6	As =	29.5	[cm^2]
Steel Reinforcement	No.	=	16			
	d	=	46	[cm]		
d (εu/(εy+εu))	Cb	=	27.818	[cm]		
	ρ of Steel	=	0.031	OK		

Main Steel Used 16 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

e b = 0.24 [cm]

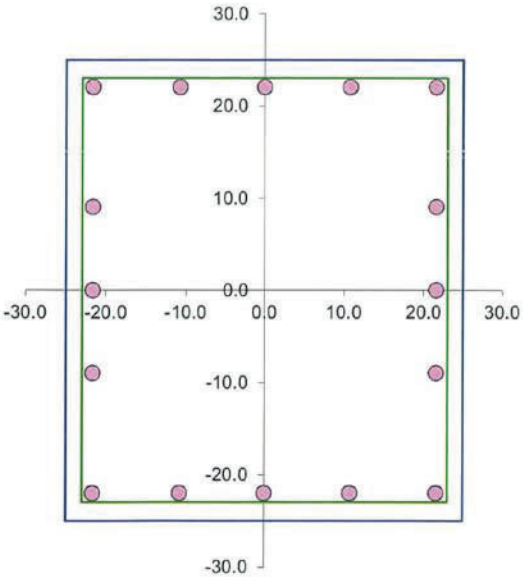




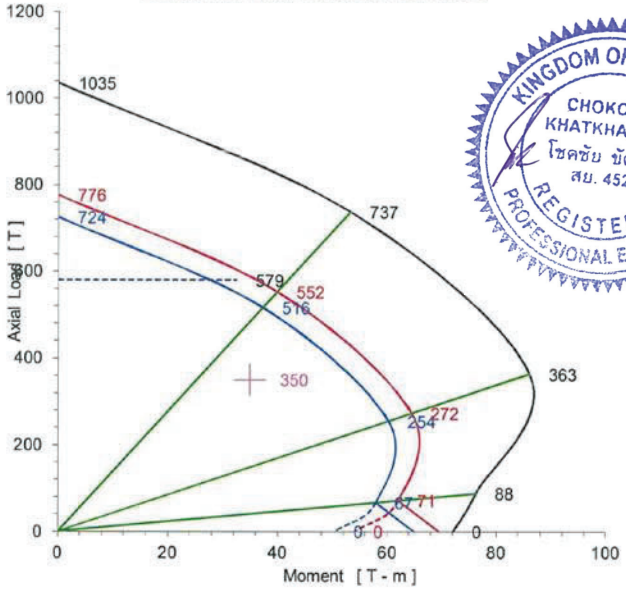
Clumn (50 x 50)
Steel 16 DB 25
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



Column C-10 (50 x 50)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	23-Dec-20

Column No. C-10 2nd-Roof

Project : อาคารทิศตะวันตก

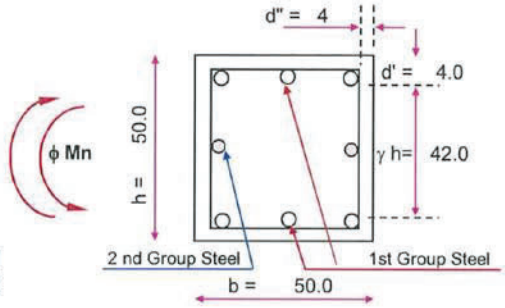
filename : COLUMN

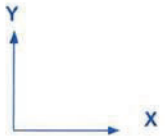
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	50	[cm]		
	h	=	50	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	125	[T]		
Moment	ϕ Mn	=	13	[T-m]		
Separate Steel 2 group	1 st.	=	10	As =	49.1	[cm^2]
	2 nd.	=	6	As =	29.5	[cm^2]
Steel Reinforcement	No.	=	16			
	d	=	46	[cm]		
d (εu/(εy+εu))	Cb	=	27.818	[cm]		
	ρ of Steel	=	0.031	OK		

Main Steel Used 16 DB 25 — DB 25

Stirrup RB 9 @ 0.400 — RB 9

e b = 0.24 [cm]

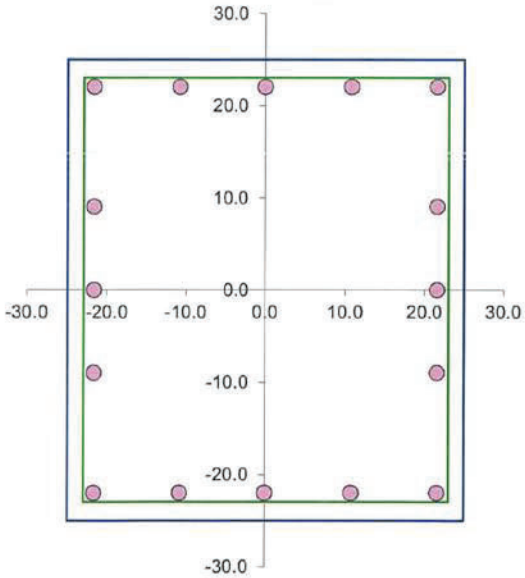




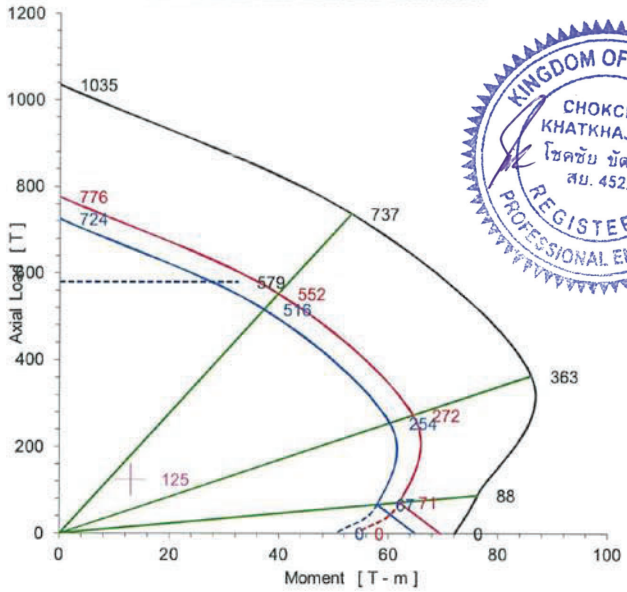
Clumn (50 x 50)
Steel 16 DB 25
Stirrup RB 9 @ 0.400

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column C-10 (50 x 50)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	8-Oct-20

Column No. CC-1 Roof FL.

Project : อาคารทิศตะวันตก

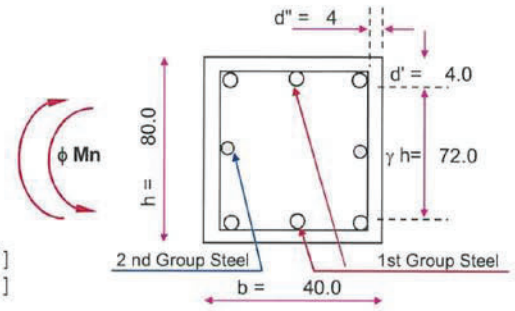
filename : COLUMN

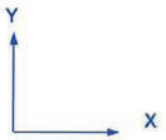
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	40	[cm]		
	h	=	80	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	7.5	[T]		
Moment	ϕ Mn	=	0.7	[T-m]		
Separate Steel 2 group	1 st.	=	8	As =	16.1	[cm^2]
	2 nd.	=	8	As =	16.1	[cm^2]
Steel Reinforcement	No.	=	16			
	d	=	76	[cm]		
d (ε u / (ε y + ε u))	Cb	=	45.960	[cm]		
	p of Steel	=	0.010	OK		

Main Steel Used 16 DB 16 — DB 16

Stirrup RB 9 @ 0.250 — RB 9

e b = 0.25 [cm]



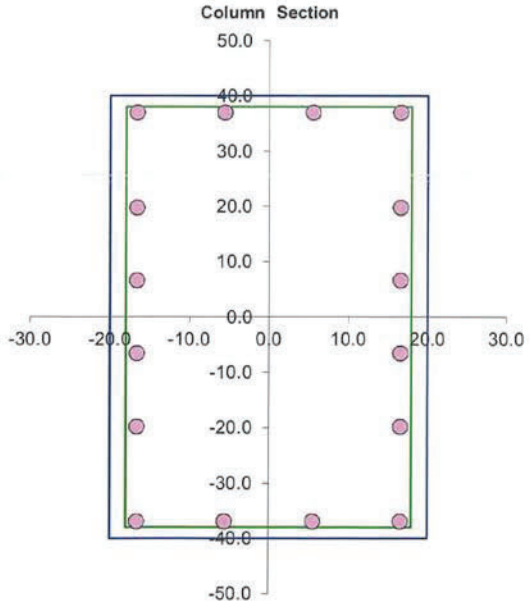


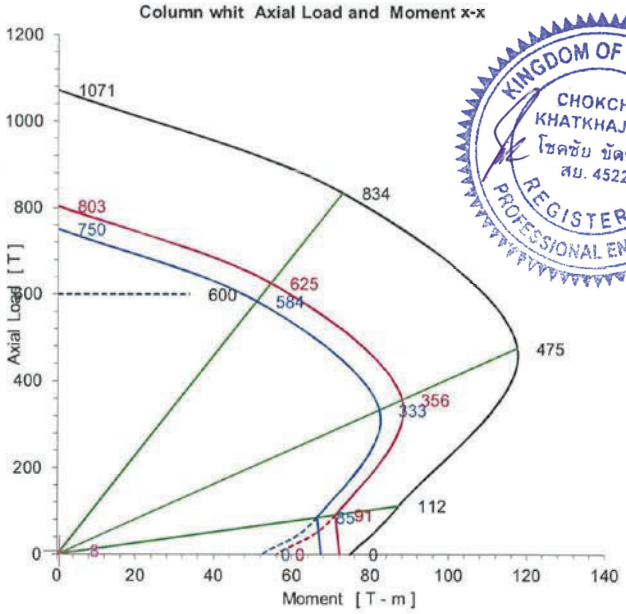
Clumn (40 x 80)

Steel 16 DB 16

Stirrup RB 9 @ 0.250

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity





Column CC-1 (40 x 80)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	8-Oct-20

Column No. CT-1 Roof FL.

Project : อาคารทิศตะวันตก

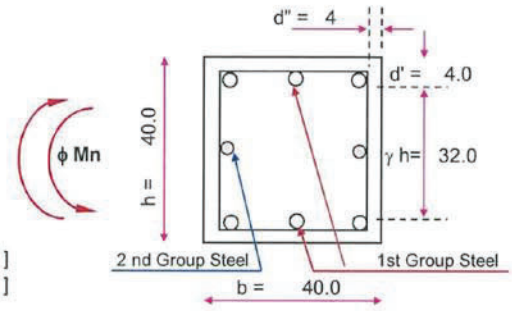
filename : COLUMN

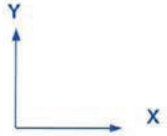
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	40	[cm]		
	h	=	40	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	5	[T]		
Moment	ϕ Mn	=	1	[T-m]		
Separate Steel 2 group	1 st.	=	8	As =	16.1	[cm^2]
	2 nd.	=	4	As =	8.0	[cm^2]
Steel Reinforcement	No.	=	12			
	d	=	36	[cm]		
d (ε u / (ε y + ε u))	Cb	=	21.771	[cm]		
	ρ of Steel	=	0.015	OK		

Main Steel Used 12 DB 16 — DB 16

Stirrup RB 9 @ 0.250 — RB 9

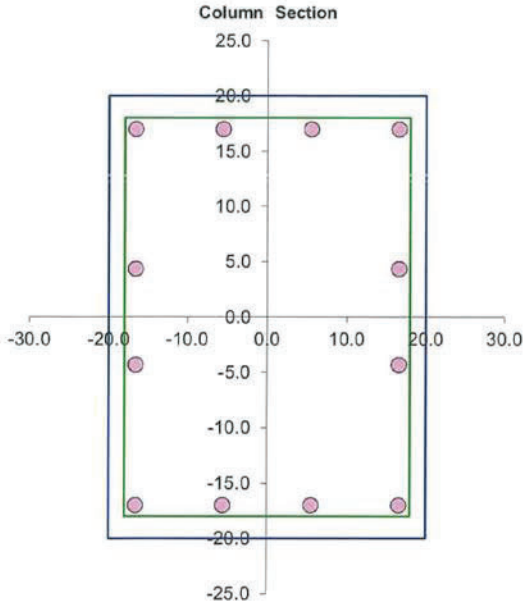
e b = 0.15 [cm]

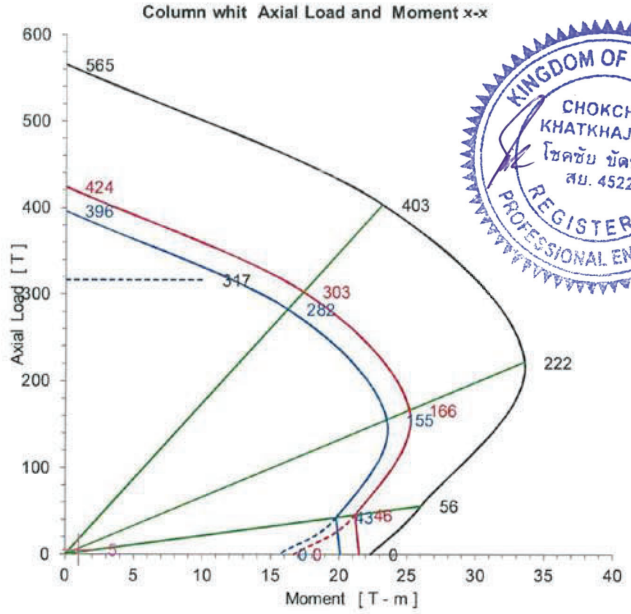




Clumn (40 x 40)
Steel 12 DB 16
Stirrup RB 9 @ 0.250

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity





Column CT-1 (40 x 40)

DYNAMIC ENGINEERING CONSULTANT CO., LTD.

Column Whit Axial Force and Moment X - X

(Ultimate Stress Design method in accordance with ACI 318)

Job No.	:	193018
Rev.	:	0
Initial	:	CKJ
Date	:	8-Oct-20

Column No. CR-1 Roof FL.

Project : อาคารทิศตะวันตก

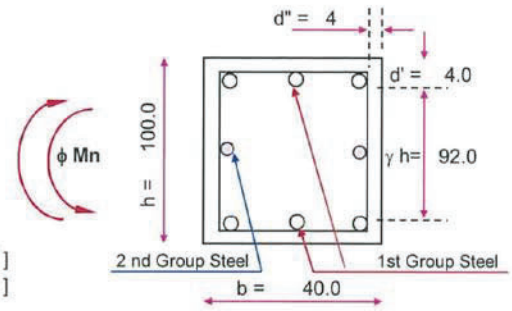
filename : COLUMN

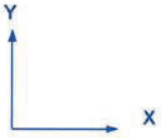
Concrete Strength	fc'	=	350	[kg/cm^2]		
	fy SD	=	4000	[kg/cm^2]		
	fy RD	=	2400	[kg/cm^2]		
Column Dimension	b	=	40	[cm]		
	h	=	100	[cm]		
	d'	=	4	[cm]		
	d"	=	4	[cm]		
Load	ϕ Pn	=	35	[T]		
Moment	ϕ Mn	=	3.5	[T-m]		
Separate Steel 2 group	1 st.	=	8	As =	25.1	[cm^2]
	2 nd.	=	10	As =	31.4	[cm^2]
Steel Reinforcement	No.	=	18			
	d	=	96	[cm]		
d (εu / (εy + εu))	Cb	=	58.055	[cm]		
	ρ of Steel	=	0.014	OK		

Main Steel Used 18 DB 20 — DB 20

Stirrup RB 9 @ 0.300 — RB 9

e b = 0.32 [cm]

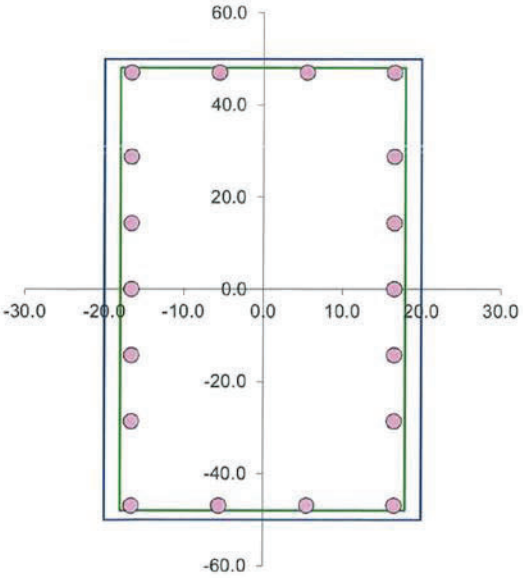




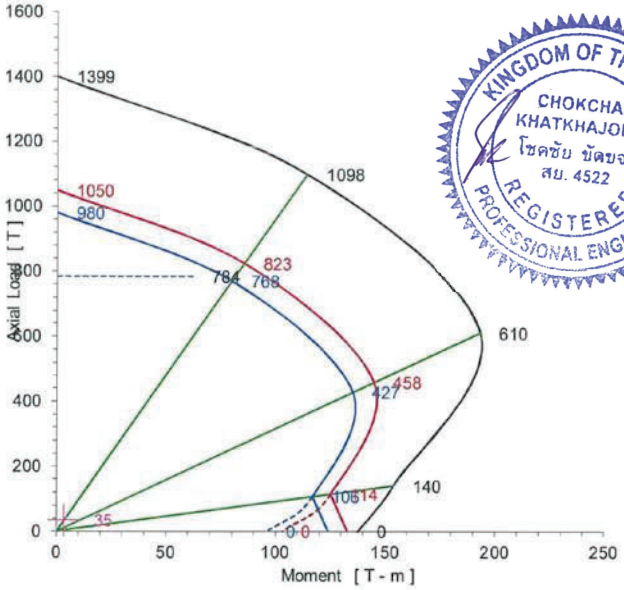
Clumn (40 x 100)
Steel 18 DB 20
Stirrup RB 9 @ 0.300

Boundary of tie stirrup Column
Boundary of sprial stirrup Column
Boundary of Ultimate Capacity

Column Section



Column whit Axial Load and Moment x-x



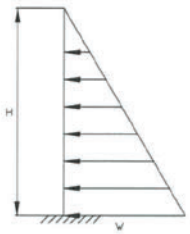
KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

Column CR-1 (40 x 100)

DYNAMIC ENGINEERING CONSULTANTS CO., LTD.
281 SOI PHANIT ANAN 7 SUKHUMVIT 71
BANGKOK 10110
PHONE: (66-2) 713-3888, FAX: (66-2) 713-3889

Project No. : 193018 **Date :** 10/1/2020
Project Name : อาคารทิศตะวันตก
Subject : WALL TANK
Made by : โชคชัย **Checked by :** โชคชัย

Member : WT 1 **SLAB DESIGN (USD)**



Pile Size	=	0.00	cm.	Conc. fc'		350	kg / cm^2		
Hight, H	=	2.50	m.	Steel fy		4000	kg / cm^2		
Water Load	=	1000	kg / m^2	β_1	=	0.80	R =	73.57	kg / cm^2
Soil Load	=	0	kg / m^2	ρ_b	=	0.036	ϕM_n =	14898	kg-m / m
W_U = 1.4W	=	2072	kg / m^2	Cover (Short Side)			=	5.00	cm
Thickness	=	20.0	cm	Cover (Long Side)			=	5.00	cm
M-pos.	=	863	kg-m / m	Required Thickness			=	8.61	cm
Max. Shear	=	2590	kg / m	Required d			=	3.61	cm

Reinforcement

ρ = 0.85*(fc' / fy) * (1-(SQR(1-(236*Mu/(ϕbd^{2}fc'))))

= 0.0011

Section Area of Steel

As.pos. = 2.15 (cm^2 / m)

As_{min} = 3.60 (cm^2 / m)

Temparature Steel

As. = 3.60 (cm^2 / m)

Bottom Steel As-pos.		Top Steel As-neg.	
Diameter (mm.)	Spacing(m.)	Diameter (mm.)	Spacing(m.)
12	0.31	12	0.31
16	0.56	16	0.56
20	0.87	20	0.87
25	1.36	25	1.36
Use Diameter = 12 mm.		Use Diameter = 12 mm.	

Check Beam Shear :

V_U = 2590 kg / m

ϕV_c = 12642 kg / m **OK**

Check Punching Shear

V_{up} = 2590 kg / m

ϕV_p = 7585 kg / m **OK**

KINGDOM OF THAILAND
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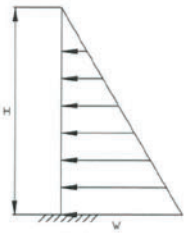
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

DYNAMIC ENGINEERING CONSULTANTS CO., LTD.
281 SOI PHANIT ANAN 7 SUKHUMVIT 71
BANGKOK 10110
PHONE: (66-2) 713-3888, FAX: (66-2) 713-3889

Project No. : 193018 **Date :** 10/1/2020
Project Name : อาคารทิศตะวันตก
Subject : กะบะปลูกต้นไม้
Made by : โชคชัย **Checked by :** โชคชัย

Member : W120 **SLAB DESIGN (USD)**



Pile Size	=	0.00	cm.	Conc. fc'		350	kg / cm^2		
Hight, H	=	0.75	m.	Steel fy		4000	kg / cm^2		
Water Load	=	0	kg / m^2	β_1	=	0.80	R =	73.57	kg / cm^2
Soil Load	=	1800	kg / m^2	ρ_b	=	0.036	ϕM_n =	16951	kg-m / m
W_U = 1.4W	=	3192	kg / m^2	Cover (Short Side)			=	4.00	cm
Thickness	=	20.0	cm	Cover (Long Side)			=	4.00	cm
M-pos.	=	120	kg-m / m	Required Thickness			=	5.34	cm
Max. Shear	=	1197	kg / m	Required d			=	1.34	cm

Reinforcement

ρ = 0.85*(fc' / fy) * (1-(SQR(1-(236*Mu/(ϕbd^{2}fc'))))

= 0.0001

Section Area of Steel

As.pos. = 0.26 (cm^2 / m)

As_{min} = 3.60 (cm^2 / m)

Temparature Steel

As. = 3.60 (cm^2 / m)

Bottom Steel As-pos.		Top Steel As-neg.	
Diameter (mm.)	Spacing(m.)	Diameter (mm.)	Spacing(m.)
9	0.18	9	0.18
12	0.31	12	0.31
16	0.56	16	0.56
20	0.87	20	0.87
Use Diameter = 9 mm.		Use Diameter = 9 mm.	

Check Beam Shear :

V_U = 1197 kg / m

ϕV_c = 13485 kg / m **OK**

Check Punching Shear

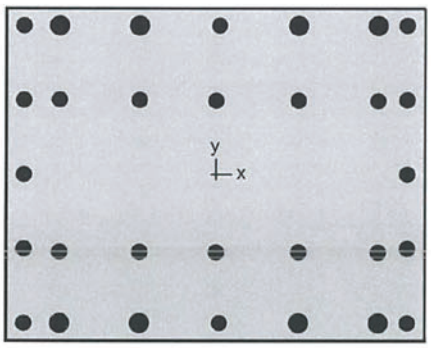
V_{up} = 1197 kg / m

ϕV_p = 8630 kg / m **OK**

KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

spColumn

spColumn v6.50
Computer program for the Strength Design of Reinforced Concrete Sections



KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

StructurePoint

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KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
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STRUCTUREPOINT - spColumn v6.50
Licensed to: Dynamic Engineering Consultants Co., Ltd.. License ID: 68794-1062303-4-2667D-XXXXX
C:\193018\GCDT\SPcloumn\10-09-63(C1 building)\SP(column)\C1-L2(revised).col

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9/18/2020
1:32 PM

1. General Information

File Name	C:\193018\GCDT\SPcloumn\10-...\C1-L2(revised).col
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

2. Material Properties

2.1. Concrete

Type	Standard	
f'_c	34	MPa
E_c	27405.5	MPa
f_c	28.9	MPa
ε_u	0.003	mm/mm
β_1	0.803444	

2.2. Steel

Type	Standard	
f_y	400	MPa
E_s	200000	MPa
ε_{yt}	0.002	mm/mm

3. Section

3.1. Shape and Properties

Type	Irregular	
A_g	800000	mm^2
I_x	4.26667e+010	mm^4
I_y	6.66667e+010	mm^4
r_x	230.94	mm
r_y	288.675	mm
X_o	0	mm
Y_o	0	mm

KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัดขจร
สย. 4522
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3.2. Section Figure

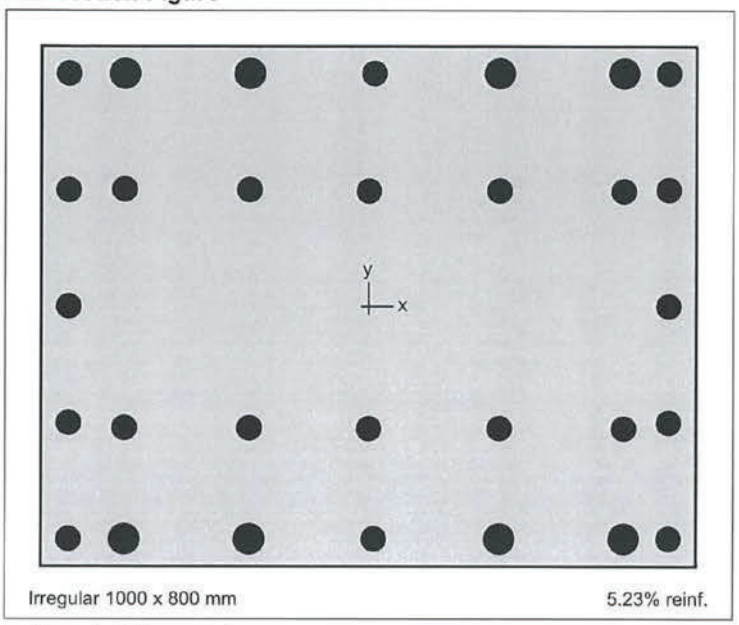

Figure 1: Column section

3.3. Exterior Points

Points	X	Y	Points	X	Y	Points	X	Y
	mm	mm		mm	mm		mm	mm
1	-500.0	-400.0	2	500.0	-400.0	3	500.0	400.0
4	-500.0	400.0						

4. Reinforcement

4.1. Bar Set: ASTM A615

Bar	Diameter	Area	Bar	Diameter	Area	Bar	Diameter	Area
	mm	mm²		mm	mm²		mm	mm²
#3	9.53	70.97	#4	12.70	129.03	#5	15.88	200.00
#6	19.05	283.87	#7	22.23	387.10	#8	25.40	509.68
#9	28.65	645.16	#10	32.26	819.35	#11	35.81	1006.45
#14	43.00	1451.61	#18	57.33	2580.64			

4.2. Confinement and Factors

Confinement type	Tied
For #10 bars or less	#3 ties
For larger bars	#4 ties
Capacity Reduction Factors	
Axial compression, (a)	0.8
Tension controlled ϕ, (b)	0.9
Compression controlled ϕ, (c)	0.65

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4.3. Arrangement

Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---

Bars	---	
Total steel area, A_s	41820	mm²
Rho	5.23	%
Minimum clear spacing	25	mm

4.4. Bars Provided

Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
1230.0	-458.0	-358.0	1230.0	-458.0	-179.0	1230.0	-458.0	0.0
1230.0	-458.0	179.0	1230.0	-458.0	358.0	1230.0	458.0	-358.0
1230.0	458.0	-179.0	1230.0	458.0	0.0	1230.0	458.0	179.0
1230.0	458.0	358.0	1845.0	-373.0	358.0	1845.0	-182.5	358.0
1230.0	8.0	358.0	1845.0	198.5	358.0	1845.0	389.0	358.0
1845.0	-373.0	-358.0	1845.0	-182.5	-358.0	1230.0	8.0	-358.0
1845.0	198.5	-358.0	1845.0	389.0	-358.0	1230.0	-373.0	-186.5
1230.0	-182.5	-187.0	1230.0	198.5	-187.8	1230.0	389.0	-188.2
1230.0	-373.0	180.3	1230.0	-182.5	179.5	1230.0	198.5	177.7
1230.0	389.0	176.9	1230.0	0.0	-188.0	1230.0	0.0	177.5

5. Factored Loads and Moments with Corresponding Capacity Ratios

NOTE: Calculations are based on "Critical Capacity" Method.

No.	Demand			Capacity			Parameters at Capacity			Capacity
	P_u	M_{ux}	M_{uy}	ϕP_n	ϕM_{nx}	ϕM_{ny}	NA Depth	ε_t	ϕ	Ratio
	kN	kNm	kNm	kN	kNm	kNm	mm			
1	-4570.00	23.90	127.50	-10707.41	353.64	1886.58	95	0.03196	0.900	0.48
2	12770.00	62.10	30.30	20092.49	62.10	30.30	1038	-0.00014	0.650	0.64
3	6550.00	165.00	638.00	12513.11	881.96	3410.23	863	0.00112	0.650	0.38
4	6962.00	334.00	182.00	20092.49	334.00	182.00	1056	-0.00011	0.650	0.35
5	8518.00	340.00	51.00	20092.49	340.00	51.00	924	-0.00033	0.650	0.42
6	8110.00	161.00	647.00	14732.07	768.06	3086.56	952	0.00071	0.650	0.42

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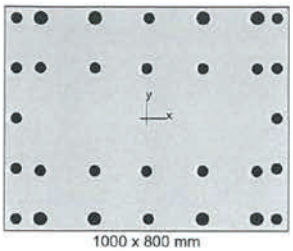
6. Diagrams

6.1. PM at θ=26 [deg]



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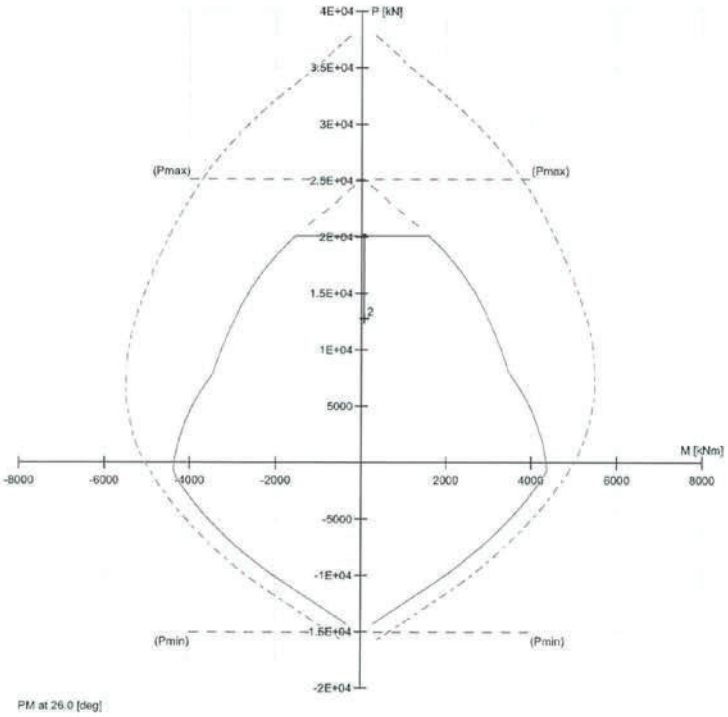

General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials		
f'_c	34	MPa
E_c	27405.5	MPa
f_y	400	MPa
E_s	200000	MPa

Section		
Type	Irregular	
A_g	800000	mm²
I_x	4.26667e+010	mm⁴
I_y	6.66667e+010	mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	41820 mm²
Rho	5.23 %
Min. clear spacing	25 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
2	12770.0	62.1	30.3	20092.49	62.10	30.30	0.64

Max. Capacity Ratio: 0.64

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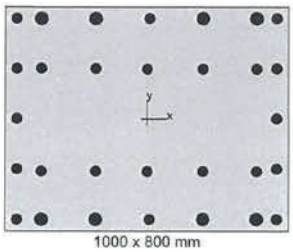
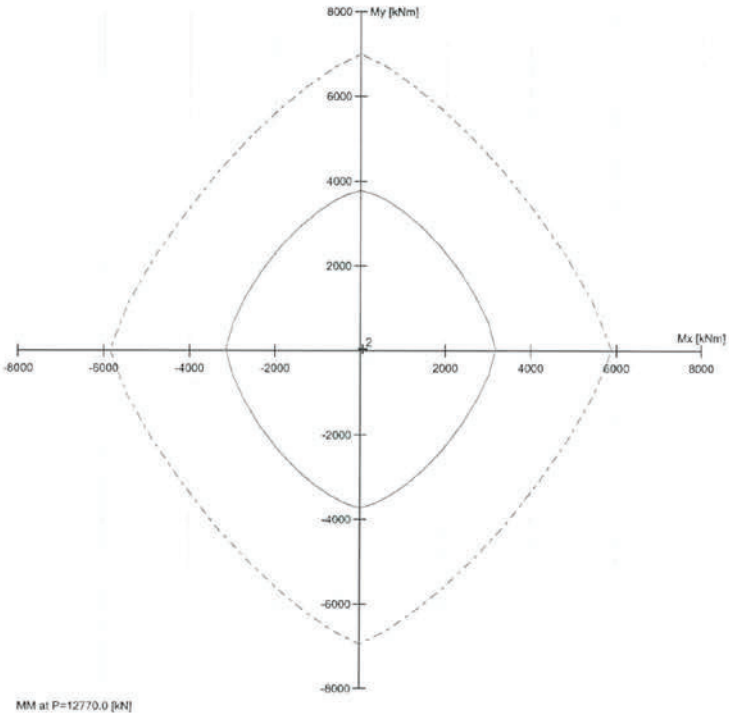
6.2. MM at P=12770 [kN]



1000 x 800 mm



General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials	
f'_c	34 MPa
E_c	27405.5 MPa
f_y	400 MPa
E_s	200000 MPa

Section	
Type	Irregular
A_g	800000 mm²
I_x	4.26667e+010 mm⁴
I_y	6.66667e+010 mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	41820 mm²
Rho	5.23 %
Min. clear spacing	25 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
2	12770.0	62.1	30.3	20092.49	62.10	30.30	0.64

Max. Capacity Ratio: 0.64

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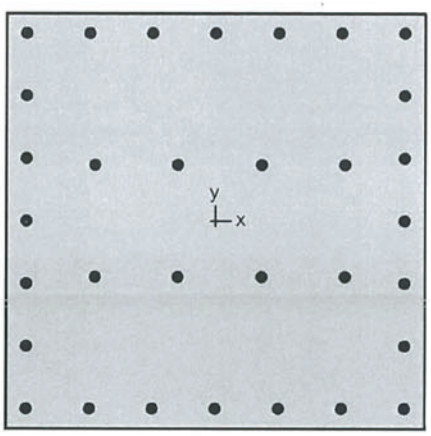
Computer program for the Strength Design of Reinforced Concrete Sections



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1. General Information

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Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

2. Material Properties

2.1. Concrete

Type	Standard	
f'_c	35	MPa
E_c	27805.6	MPa
f_c	29.75	MPa
ε_u	0.003	mm/mm
β_1	0.796192	

2.2. Steel

Type	Standard	
f_y	400	MPa
E_s	200000	MPa
ε_{yt}	0.002	mm/mm

3. Section

3.1. Shape and Properties

Type	Irregular	
A_g	1.44e+006	mm^2
I_x	1.728e+011	mm^4
I_y	1.728e+011	mm^4
r_x	346.41	mm
r_y	346.41	mm
X_o	0	mm
Y_o	0	mm

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3.2. Section Figure

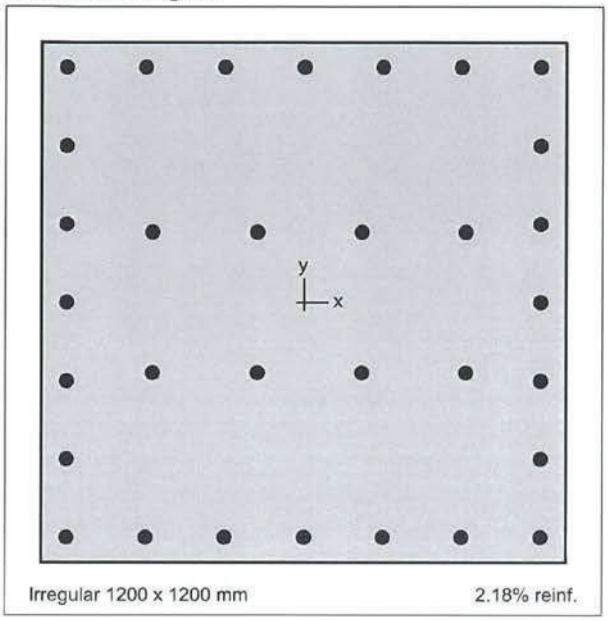

Figure 1: Column section

3.3. Exterior Points

Points	X mm	Y mm	Points	X mm	Y mm	Points	X mm	Y mm
1	-600.0	-600.0	2	600.0	-600.0	3	600.0	600.0
4	-600.0	600.0						

4. Reinforcement

4.1. Bar Set: ASTM A615

Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²
#3	9.53	70.97	#4	12.70	129.03	#5	15.88	200.00
#6	19.05	283.87	#7	22.23	387.10	#8	25.40	509.68
#9	28.65	645.16	#10	32.26	819.35	#11	35.81	1006.45
#14	43.00	1451.61	#18	57.33	2580.64			

4.2. Confinement and Factors

Confinement type	Tied
For #10 bars or less	#3 ties
For larger bars	#4 ties
Capacity Reduction Factors	
Axial compression, (a)	0.8
Tension controlled ϕ, (b)	0.9
Compression controlled ϕ, (c)	0.65

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4.3. Arrangement

Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---

Bars	---
Total steel area, A_s	31424 mm²
Rho	2.18 %
Minimum clear spacing	137 mm

4.4. Bars Provided

Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
982.0	-542.3	-542.3	982.0	-542.3	-361.5	982.0	-542.3	-180.8
982.0	-542.3	0.0	982.0	-542.3	180.8	982.0	-542.3	361.5
982.0	-542.3	542.3	982.0	-361.5	-542.3	982.0	-180.8	-542.3
982.0	0.0	-542.3	982.0	180.8	-542.3	982.0	361.5	-542.3
982.0	542.3	-542.3	982.0	542.3	-361.5	982.0	542.3	-180.8
982.0	542.3	0.0	982.0	542.3	180.8	982.0	542.3	361.5
982.0	542.3	542.3	982.0	-361.5	542.3	982.0	-180.8	542.3
982.0	0.0	542.3	982.0	180.8	542.3	982.0	361.5	542.3
982.0	-346.0	162.0	982.0	-107.0	162.0	982.0	132.1	162.0
982.0	371.1	162.0	982.0	-346.0	-162.0	982.0	-107.0	-162.0
982.0	132.1	-162.0	982.0	371.1	-162.0			

5. Factored Loads and Moments with Corresponding Capacity Ratios

NOTE: Calculations are based on "Critical Capacity" Method.

No.	Demand			Capacity			Parameters at Capacity			Capacity Ratio
	P_u	M_{ux}	M_{uy}	ϕP_n	ϕM_{nx}	ϕM_{ny}	NA Depth	ε_t	ϕ	
	kN	kNm	kNm	kN	kNm	kNm	mm			
1	4447.00	137.00	259.00	0.00	2604.72	4924.26	482	0.00646	0.900	0.18
2	22110.00	155.00	87.50	28326.86	155.00	87.50	1484	0.00006	0.650	0.78
3	14460.00	349.00	3255.00	19904.94	597.68	5574.39	1007	0.00085	0.650	0.64
4	13900.00	1050.00	2640.00	20583.60	1942.03	4882.82	1170	0.00090	0.650	0.57

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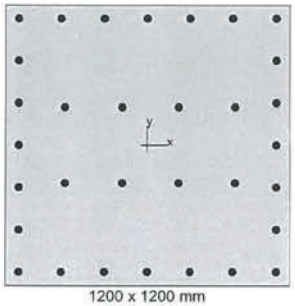
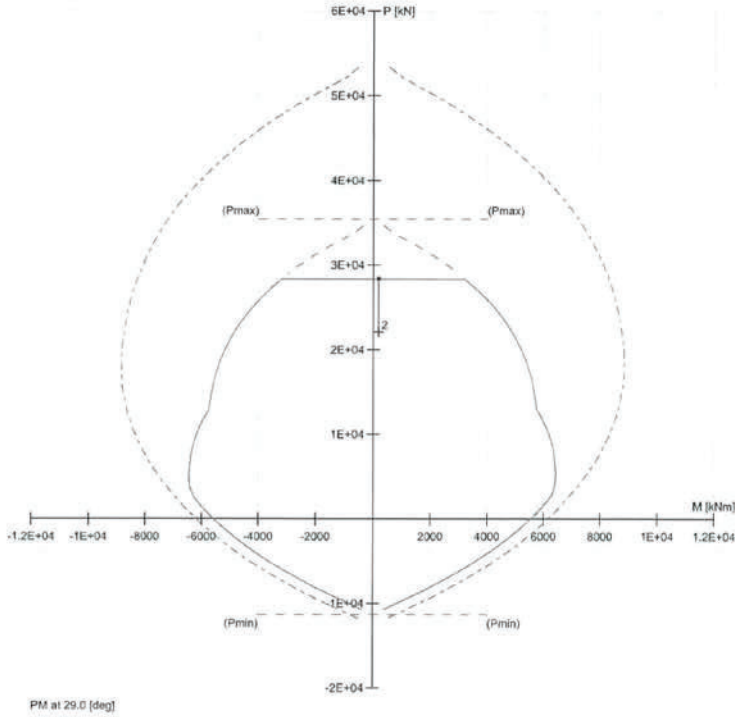
6. Diagrams

6.1. PM at θ=29 [deg]



1200 x 1200 mm



General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials	
f'_c	35 MPa
E_c	27805.6 MPa
f_y	400 MPa
E_s	200000 MPa

Section	
Type	Irregular
A_g	1.44e+006 mm²
I_x	1.728e+011 mm⁴
I_y	1.728e+011 mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	31424 mm²
Rho	2.18 %
Min. clear spacing	137 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
2	22110.0	155.0	87.5	28326.86	155.00	87.50	0.78

Max. Capacity Ratio: 0.78

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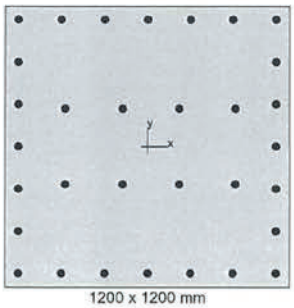
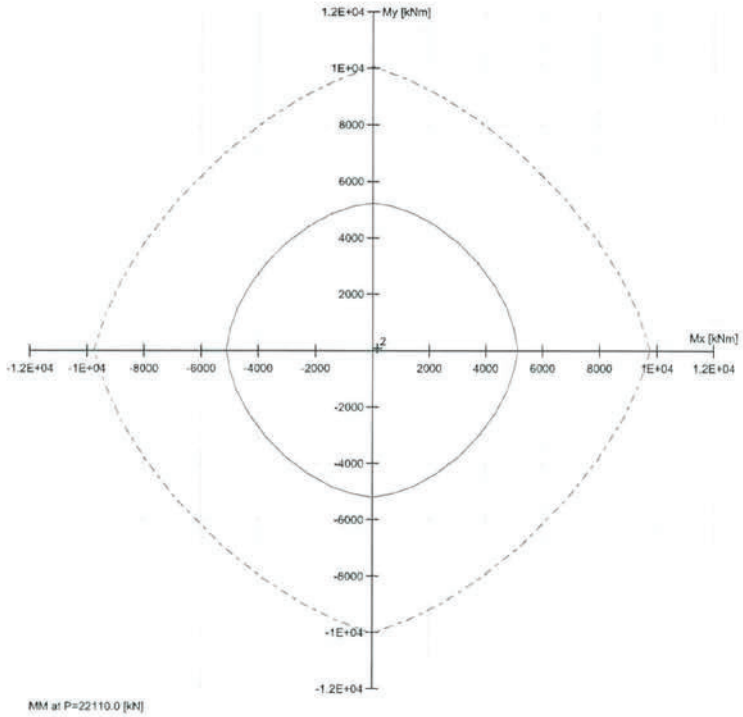
6.2. MM at P=22110 [kN]



1200 x 1200 mm



General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials	
f'_c	35 MPa
E_c	27805.6 MPa
f_y	400 MPa
E_s	200000 MPa

Section	
Type	Irregular
A_g	1.44e+006 mm²
I_x	1.728e+011 mm⁴
I_y	1.728e+011 mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	31424 mm²
Rho	2.18 %
Min. clear spacing	137 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
2	22110.0	155.0	87.5	28326.86	155.00	87.50	0.78

Max. Capacity Ratio: 0.78

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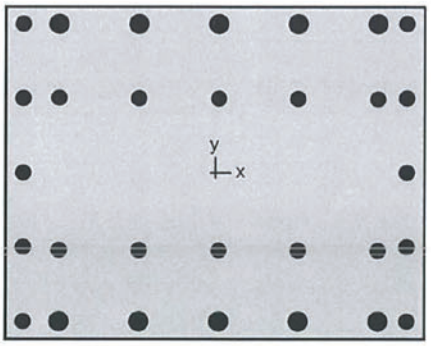
spColumn

spColumn v6.50
Computer program for the Strength Design of Reinforced Concrete Sections



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1. General Information

File Name	C:\193018\GCDT\SPcloumn\10-09-63(C1 ...\C3-L2.col
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

2. Material Properties

2.1. Concrete

Type	Standard	
f'_c	34	MPa
E_c	27405.5	MPa
f_c	28.9	MPa
ε_u	0.003	mm/mm
β_1	0.803444	

2.2. Steel

Type	Standard	
f_y	400	MPa
E_s	200000	MPa
ε_{yt}	0.002	mm/mm

3. Section

3.1. Shape and Properties

Type	Irregular	
A_g	800000	mm^2
I_x	4.26667e+010	mm^4
I_y	6.66667e+010	mm^4
r_x	230.94	mm
r_y	288.675	mm
X_o	0	mm
Y_o	0	mm

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3.2. Section Figure

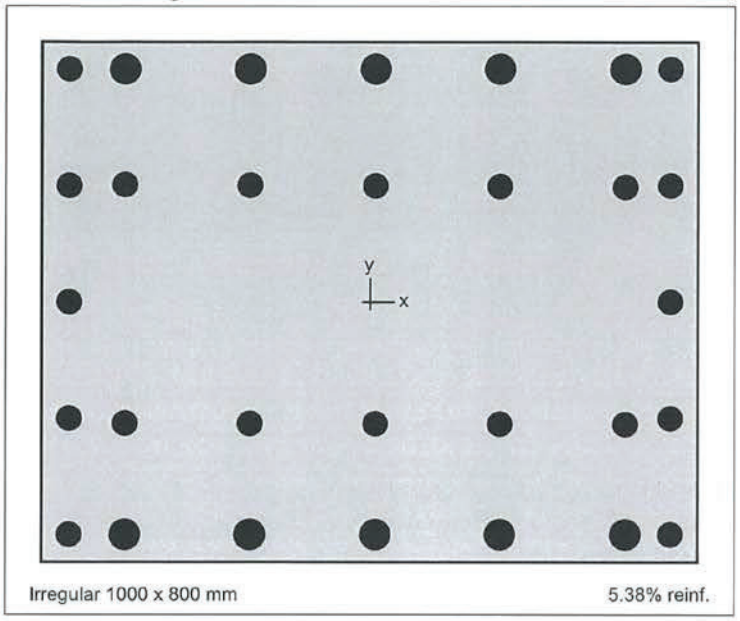

Figure 1: Column section

3.3. Exterior Points

Points	X	Y	Points	X	Y	Points	X	Y
	mm	mm		mm	mm		mm	mm
1	-500.0	-400.0	2	500.0	-400.0	3	500.0	400.0
4	-500.0	400.0						

4. Reinforcement

4.1. Bar Set: ASTM A615

Bar	Diameter	Area	Bar	Diameter	Area	Bar	Diameter	Area
	mm	mm²		mm	mm²		mm	mm²
#3	9.53	70.97	#4	12.70	129.03	#5	15.88	200.00
#6	19.05	283.87	#7	22.23	387.10	#8	25.40	509.68
#9	28.65	645.16	#10	32.26	819.35	#11	35.81	1006.45
#14	43.00	1451.61	#18	57.33	2580.64			

4.2. Confinement and Factors

Confinement type	Tied
For #10 bars or less	#3 ties
For larger bars	#4 ties
Capacity Reduction Factors	
Axial compression, (a)	0.8
Tension controlled ϕ, (b)	0.9
Compression controlled ϕ, (c)	0.65

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4.3. Arrangement

Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---

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Bars	---
Total steel area, A_s	43050 mm^2
Rho	5.38 %
Minimum clear spacing	25 mm

4.4. Bars Provided

Area	X	Y	Area	X	Y	Area	X	Y
mm^2	mm	mm	mm^2	mm	mm	mm^2	mm	mm
1230.0	-458.0	-358.0	1230.0	-458.0	-179.0	1230.0	-458.0	0.0
1230.0	-458.0	179.0	1230.0	-458.0	358.0	1230.0	458.0	-358.0
1230.0	458.0	-179.0	1230.0	458.0	0.0	1230.0	458.0	179.0
1230.0	458.0	358.0	1845.0	-373.0	358.0	1845.0	-182.5	358.0
1845.0	8.0	358.0	1845.0	198.5	358.0	1845.0	389.0	358.0
1845.0	-373.0	-358.0	1845.0	-182.5	-358.0	1845.0	8.0	-358.0
1845.0	198.5	-358.0	1845.0	389.0	-358.0	1230.0	-373.0	-186.5
1230.0	-182.5	-187.0	1230.0	8.0	-187.4	1230.0	198.5	-187.8
1230.0	389.0	-188.2	1230.0	-373.0	180.3	1230.0	-182.5	179.5
1230.0	8.0	178.6	1230.0	198.5	177.7	1230.0	389.0	176.9

5. Factored Loads and Moments with Corresponding Capacity Ratios

NOTE: Calculations are based on "Critical Capacity" Method.

No.	Demand			Capacity			Parameters at Capacity			Capacity
	P_u	M_{ux}	M_{uy}	ϕP_n	ϕM_{nx}	ϕM_{ny}	NA Depth	ε_t	ϕ	Ratio
	kN	kNm	kNm	kN	kNm	kNm	mm			
1	1990.00	17.00	13.00	8297.90	2755.45	2107.11	692	0.00193	0.650	0.15
2	16420.00	21.00	19.00	20329.85	21.00	19.00	1163	-0.00005	0.650	0.81
3	11230.00	218.00	401.00	20329.85	218.00	401.00	1238	-0.00005	0.650	0.55
4	11370.00	339.00	50.00	20329.85	339.00	50.00	925	-0.00034	0.650	0.56
5	12470.00	385.00	341.00	20329.85	385.00	341.00	1159	-0.00005	0.650	0.61
6	12350.00	240.00	460.00	20329.85	240.00	460.00	1238	-0.00005	0.650	0.61

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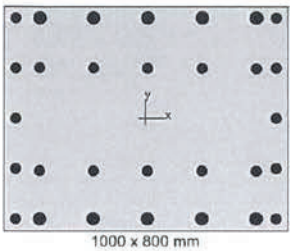
6. Diagrams

6.1. PM at θ=42 [deg]



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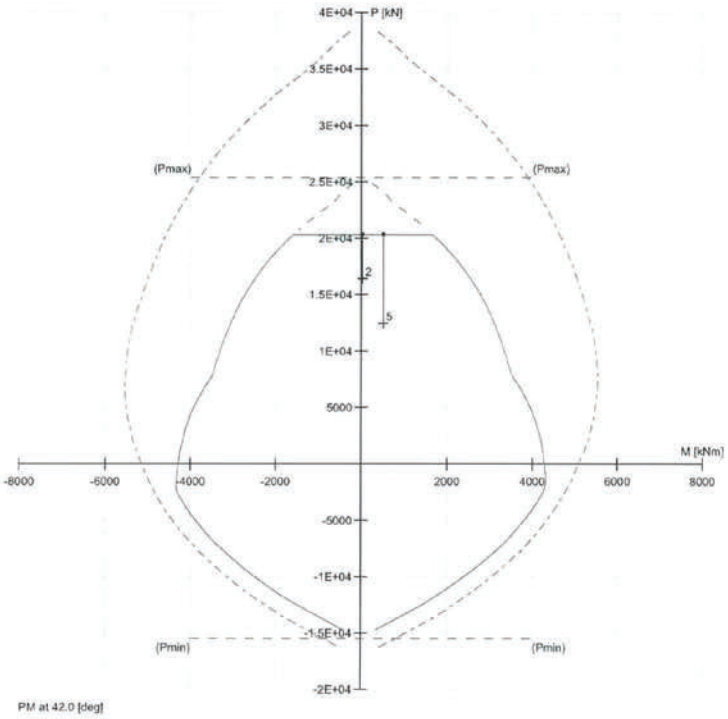

General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials	
f'_c	34 MPa
E_c	27405.5 MPa
f_y	400 MPa
E_s	200000 MPa

Section	
Type	Irregular
A_g	800000 mm²
I_x	4.26667e+010 mm⁴
I_y	6.66667e+010 mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	43050 mm²
Rho	5.38 %
Min. clear spacing	25 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
2	16420.0	21.0	19.0	20329.85	21.00	19.00	0.81
5	12470.0	385.0	341.0	20329.85	385.00	341.00	0.61

Max. Capacity Ratio: 0.81

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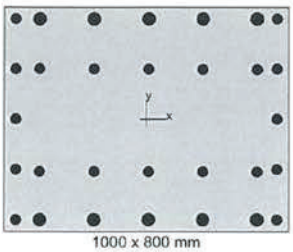
6.2. MM at P=16420 [kN]



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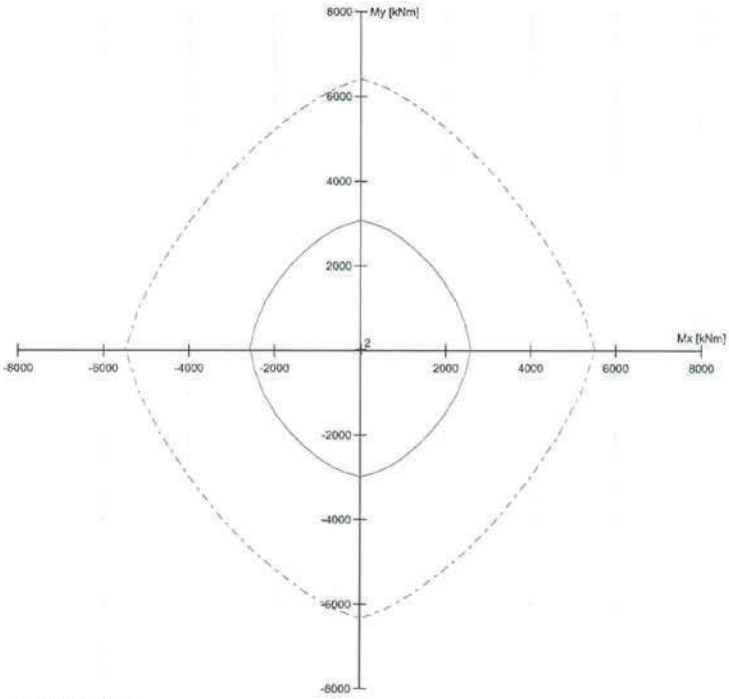

General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials	
f'_c	34 MPa
E_c	27405.5 MPa
f_y	400 MPa
E_s	200000 MPa

Section	
Type	Irregular
A_g	800000 mm²
I_x	4.26667e+010 mm⁴
I_y	6.66667e+010 mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	43050 mm²
Rho	5.38 %
Min. clear spacing	25 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
2	16420.0	21.0	19.0	20329.85	21.00	19.00	0.81

Max. Capacity Ratio: 0.81

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spColumn

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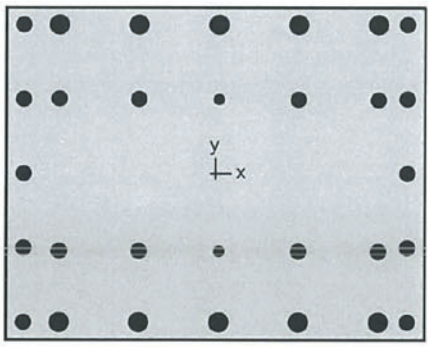
Computer program for the Strength Design of Reinforced Concrete Sections



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1. General Information

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Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

2. Material Properties

2.1. Concrete

Type	Standard	
f'_c	34	MPa
E_c	27405.5	MPa
f_c	28.9	MPa
ε_u	0.003	mm/mm
β_1	0.803444	

2.2. Steel

Type	Standard	
f_y	400	MPa
E_s	200000	MPa
ε_{yt}	0.002	mm/mm

3. Section

3.1. Shape and Properties

Type	Irregular	
A_g	800000	mm^2
I_x	4.26667e+010	mm^4
I_y	6.66667e+010	mm^4
r_x	230.94	mm
r_y	288.675	mm
X_o	0	mm
Y_o	0	mm

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3.2. Section Figure

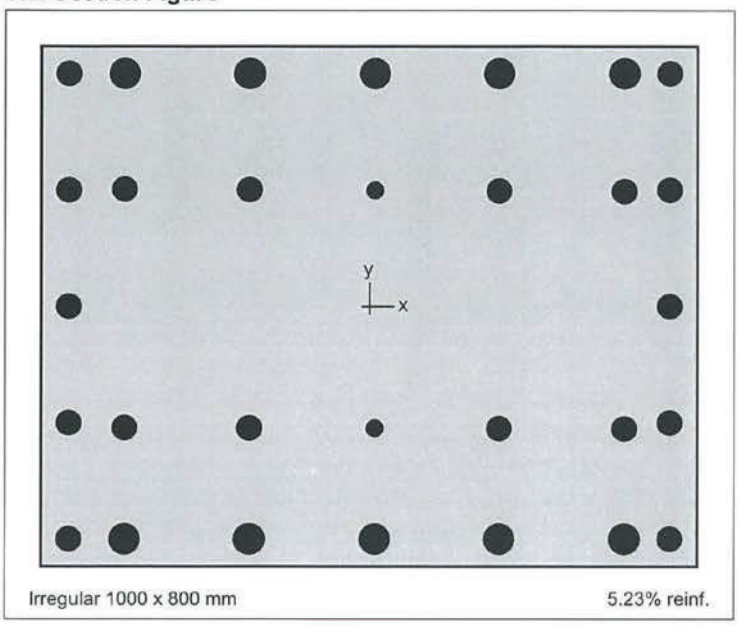

Figure 1: Column section

3.3. Exterior Points

Points	X mm	Y mm	Points	X mm	Y mm	Points	X mm	Y mm
1	-500.0	-400.0	2	500.0	-400.0	3	500.0	400.0
4	-500.0	400.0						

4. Reinforcement

4.1. Bar Set: ASTM A615

Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²
#3	9.53	70.97	#4	12.70	129.03	#5	15.88	200.00
#6	19.05	283.87	#7	22.23	387.10	#8	25.40	509.68
#9	28.65	645.16	#10	32.26	819.35	#11	35.81	1006.45
#14	43.00	1451.61	#18	57.33	2580.64			

4.2. Confinement and Factors

Confinement type	Tied
For #10 bars or less	#3 ties
For larger bars	#4 ties
Capacity Reduction Factors	
Axial compression, (a)	0.8
Tension controlled ϕ, (b)	0.9
Compression controlled ϕ, (c)	0.65

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4.3. Arrangement

Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---

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Bars	---
Total steel area, A_s	41820 mm²
Rho	5.23 %
Minimum clear spacing	25 mm

4.4. Bars Provided

Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
1230.0	-458.0	-358.0	1230.0	-458.0	-179.0	1230.0	-458.0	0.0
1230.0	-458.0	179.0	1230.0	-458.0	358.0	1230.0	458.0	-358.0
1230.0	458.0	-179.0	1230.0	458.0	0.0	1230.0	458.0	179.0
1230.0	458.0	358.0	1845.0	-373.0	358.0	1845.0	-182.5	358.0
1845.0	8.0	358.0	1845.0	198.5	358.0	1845.0	389.0	358.0
1845.0	-373.0	-358.0	1845.0	-182.5	-358.0	1845.0	8.0	-358.0
1845.0	198.5	-358.0	1845.0	389.0	-358.0	1230.0	-373.0	-186.5
1230.0	-182.5	-187.0	615.0	8.0	-187.4	1230.0	198.5	-187.8
1230.0	389.0	-188.2	1230.0	-373.0	180.3	1230.0	-182.5	179.5
615.0	8.0	178.6	1230.0	198.5	177.7	1230.0	389.0	176.9

5. Factored Loads and Moments with Corresponding Capacity Ratios

NOTE: Calculations are based on "Critical Capacity" Method.

No.	Demand			Capacity			Parameters at Capacity			Capacity Ratio
	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	NA Depth mm	ε_t	ϕ	
1	2160.00	2.00	14.00	8886.83	591.95	4143.68	691	0.00184	0.650	0.19
2	16460.00	41.00	32.00	20092.49	41.00	32.00	1130	-0.00006	0.650	0.82
3	8060.00	12.00	599.00	14224.73	69.99	3493.55	811	0.00063	0.650	0.43
4	11170.00	624.00	78.00	20092.49	624.00	78.00	917	-0.00035	0.650	0.56
5	11690.00	27.00	632.00	20092.49	27.00	632.00	1116	-0.00033	0.650	0.58

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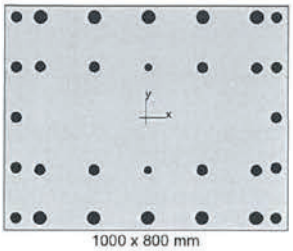
6. Diagrams

6.1. PM at θ=38 [deg]



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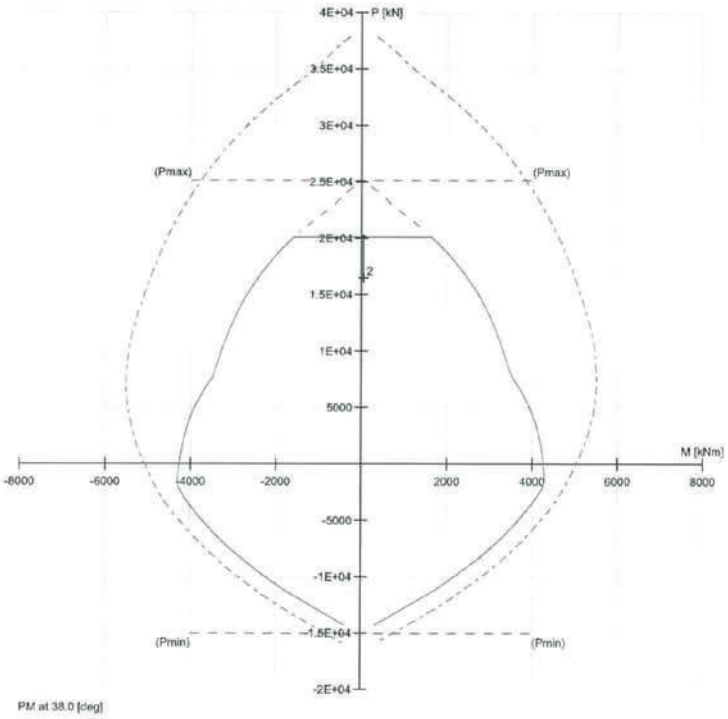

General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials		
f'_c	34	MPa
E_c	27405.5	MPa
f_y	400	MPa
E_s	200000	MPa

Section		
Type	Irregular	
A_g	800000	mm²
I_x	4.26667e+010	mm⁴
I_y	6.66667e+010	mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	41820 mm²
Rho	5.23 %
Min. clear spacing	25 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
2	16460.0	41.0	32.0	20092.49	41.00	32.00	0.82

Max. Capacity Ratio: 0.82

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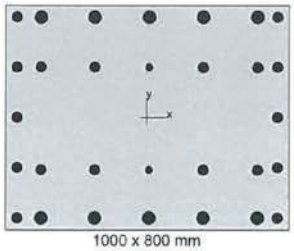
6.2. MM at P=16460 [kN]



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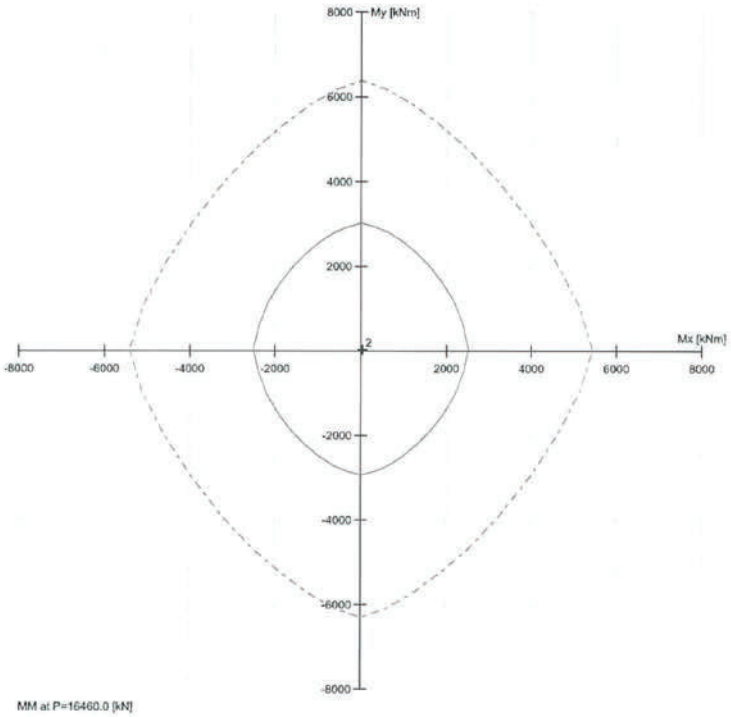

General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials		
f'_c	34	MPa
E_c	27405.5	MPa
f_y	400	MPa
E_s	200000	MPa

Section		
Type	Irregular	
A_g	800000	mm²
I_x	4.26667e+010	mm⁴
I_y	6.66667e+010	mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	41820 mm²
Rho	5.23 %
Min. clear spacing	25 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
2	16460.0	41.0	32.0	20092.49	41.00	32.00	0.82

Max. Capacity Ratio: 0.82

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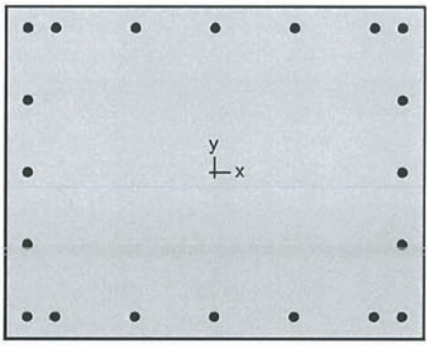
spColumn

spColumn v6.50
Computer program for the Strength Design of Reinforced Concrete Sections



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1. General Information

File Name	C:\193018\GCDT\SPcloumn\10-09-63(C1 ...\C5-L2.col
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

2. Material Properties

2.1. Concrete

Type	Standard	
f'_c	34	MPa
E_c	27405.5	MPa
f_c	28.9	MPa
ε_u	0.003	mm/mm
β_1	0.803444	

2.2. Steel

Type	Standard	
f_y	400	MPa
E_s	200000	MPa
ε_{yt}	0.002	mm/mm

3. Section

3.1. Shape and Properties

Type	Irregular	
A_g	800000	mm^2
I_x	4.26667e+010	mm^4
I_y	6.66667e+010	mm^4
r_x	230.94	mm
r_y	288.675	mm
X_o	0	mm
Y_o	0	mm

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โชคชัย ขัดขจร
สย. 4522
REGISTERED PROFESSIONAL ENGINEER

STRUCTUREPOINT - spColumn v6.50
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3.2. Section Figure

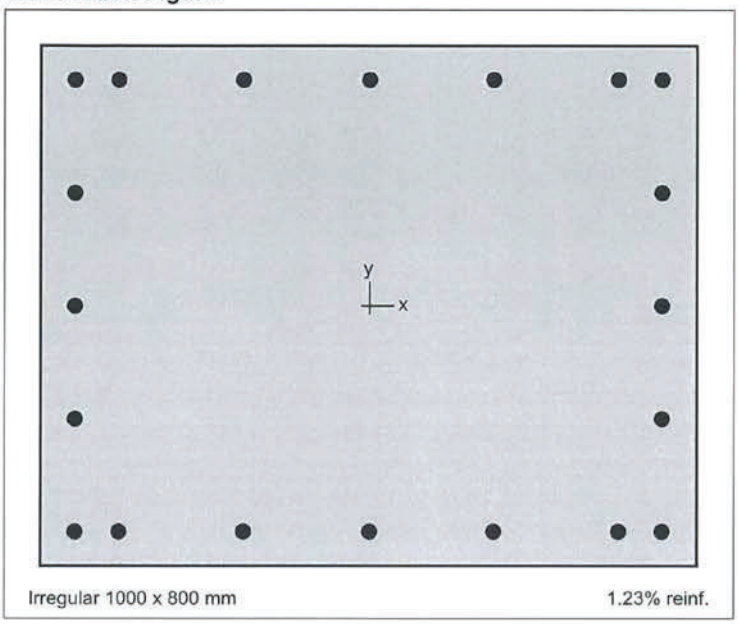

Figure 1: Column section

3.3. Exterior Points

Points	X mm	Y mm	Points	X mm	Y mm	Points	X mm	Y mm
1	-500.0	-400.0	2	500.0	-400.0	3	500.0	400.0
4	-500.0	400.0						

4. Reinforcement

4.1. Bar Set: ASTM A615

Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²
#3	9.53	70.97	#4	12.70	129.03	#5	15.88	200.00
#6	19.05	283.87	#7	22.23	387.10	#8	25.40	509.68
#9	28.65	645.16	#10	32.26	819.35	#11	35.81	1006.45
#14	43.00	1451.61	#18	57.33	2580.64			

4.2. Confinement and Factors

Confinement type	Tied
For #10 bars or less	#3 ties
For larger bars	#4 ties
Capacity Reduction Factors	
Axial compression, (a)	0.8
Tension controlled ϕ, (b)	0.9
Compression controlled ϕ, (c)	0.65

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4.3. Arrangement

Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---

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Bars	---
Total steel area, A_s	9820 mm²
Rho	1.23 %
Minimum clear spacing	41 mm

4.4. Bars Provided

Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
491.0	-447.5	-347.5	491.0	-447.5	-173.7	491.0	-447.5	0.0
491.0	-447.5	173.7	491.0	-447.5	347.5	491.0	447.5	-347.5
491.0	447.5	-173.7	491.0	447.5	0.0	491.0	447.5	173.7
491.0	447.5	347.5	491.0	-381.0	347.5	491.0	-190.5	347.5
491.0	0.0	347.5	491.0	190.5	347.5	491.0	381.0	347.5
491.0	-381.0	-347.5	491.0	-190.5	-347.5	491.0	0.0	-347.5
491.0	190.5	-347.5	491.0	381.0	-347.5			

5. Factored Loads and Moments with Corresponding Capacity Ratios

NOTE: Calculations are based on "Critical Capacity" Method.

No.	Demand			Capacity			Parameters at Capacity			Capacity
	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	NA Depth mm	ε_t	ϕ	Ratio
1	334.00	0.00	0.00	355.04	1381.42	0.00	93	0.02119	0.900	0.46
2	2630.00	38.00	21.00	0.00	1192.95	659.26	206	0.01072	0.900	0.36
3	1030.00	39.00	110.00	0.00	529.23	1492.70	254	0.01053	0.900	0.41
4	1030.00	124.00	23.00	0.00	1241.84	230.34	124	0.01922	0.900	0.51
5	2070.00	30.00	129.00	0.00	358.43	1541.26	206	0.01286	0.900	0.45

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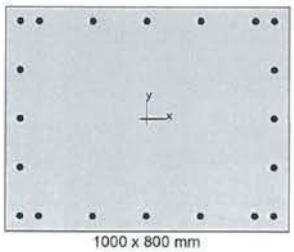
6. Diagrams

6.1. PM at θ=11 [deg]



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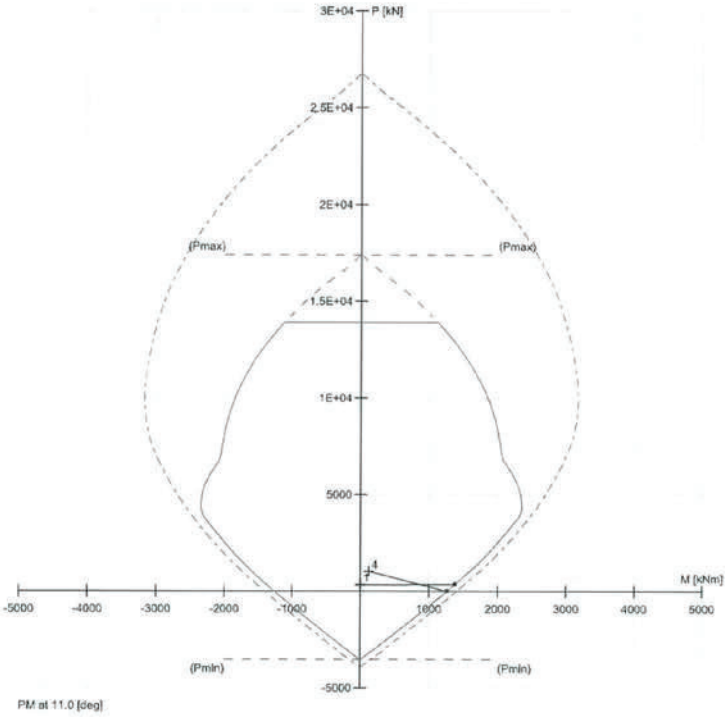

General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials	
f'_c	34 MPa
E_c	27405.5 MPa
f_y	400 MPa
E_s	200000 MPa

Section	
Type	Irregular
A_g	800000 mm²
I_x	4.26667e+010 mm⁴
I_y	6.66667e+010 mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	9820 mm²
Rho	1.23 %
Min. clear spacing	41 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
4	1030.0	124.0	23.0	0.00	1241.84	230.34	0.51
1	334.0	0.0	0.0	355.04	1381.42	0.00	0.46

Max. Capacity Ratio: 0.51

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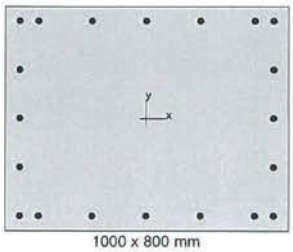
6.2. MM at P=1030 [kN]



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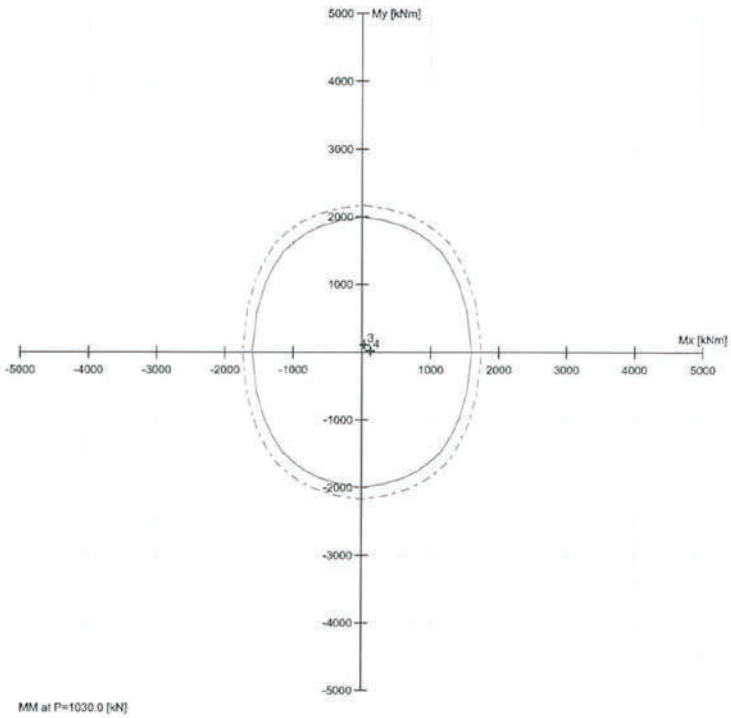

General Information

Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials

f'_c	34 MPa
E_c	27405.5 MPa
f_y	400 MPa
E_s	200000 MPa

Section

Type	Irregular
A_g	800000 mm²
I_x	4.26667e+010 mm⁴
I_y	6.66667e+010 mm⁴

Reinforcement

Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	9820 mm²
Rho	1.23 %
Min. clear spacing	41 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
4	1030.0	124.0	23.0	0.00	1241.84	230.34	0.51
3	1030.0	39.0	110.0	0.00	529.23	1492.70	0.41

Max. Capacity Ratio: 0.51

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spColumn

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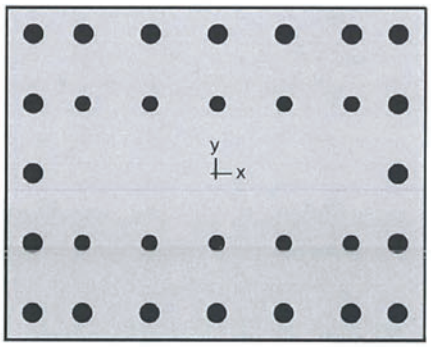
Computer program for the Strength Design of Reinforced Concrete Sections



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1. General Information

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Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

2. Material Properties

2.1. Concrete

Type	Standard	
f'_c	34	MPa
E_c	27405.5	MPa
f_c	28.9	MPa
ε_u	0.003	mm/mm
β_1	0.803444	

2.2. Steel

Type	Standard	
f_y	400	MPa
E_s	200000	MPa
ε_{yt}	0.002	mm/mm

3. Section

3.1. Shape and Properties

Type	Irregular	
A_g	800000	mm^2
I_x	4.26667e+010	mm^4
I_y	6.66667e+010	mm^4
r_x	230.94	mm
r_y	288.675	mm
X_o	0	mm
Y_o	0	mm

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3.2. Section Figure

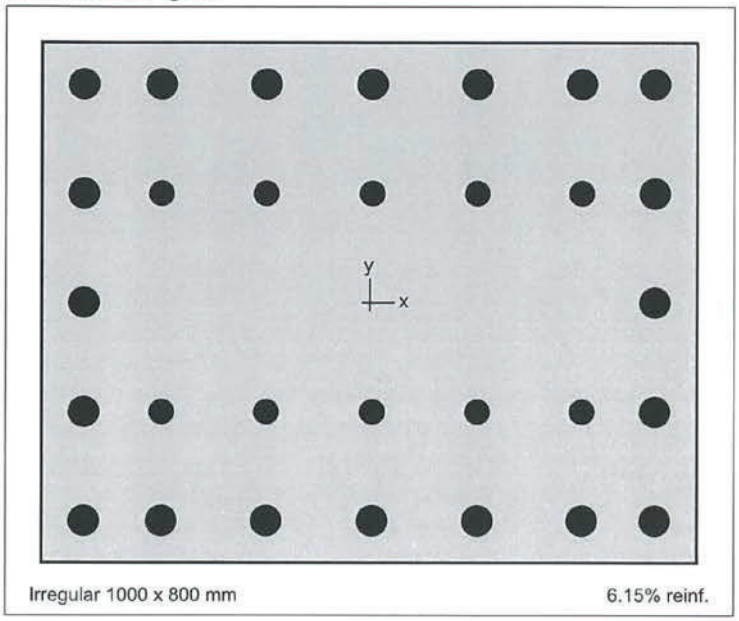

Figure 1: Column section

3.3. Exterior Points

Points	X mm	Y mm	Points	X mm	Y mm	Points	X mm	Y mm
1	-500.0	-400.0	2	500.0	-400.0	3	500.0	400.0
4	-500.0	400.0						

4. Reinforcement

4.1. Bar Set: ASTM A615

Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²
#3	9.53	70.97	#4	12.70	129.03	#5	15.88	200.00
#6	19.05	283.87	#7	22.23	387.10	#8	25.40	509.68
#9	28.65	645.16	#10	32.26	819.35	#11	35.81	1006.45
#14	43.00	1451.61	#18	57.33	2580.64			

4.2. Confinement and Factors

Confinement type	Tied
For #10 bars or less	#3 ties
For larger bars	#4 ties
Capacity Reduction Factors	
Axial compression, (a)	0.8
Tension controlled ϕ, (b)	0.9
Compression controlled ϕ, (c)	0.65

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4.3. Arrangement

Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---

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Bars	---
Total steel area, A_s	49200 mm²
Rho	6.15 %
Minimum clear spacing	63 mm

4.4. Bars Provided

Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
1845.0	-435.8	-335.8	1845.0	-435.8	-167.9	1845.0	-435.8	0.0
1845.0	-435.8	167.9	1845.0	-435.8	335.8	1845.0	435.8	-335.8
1845.0	435.8	-167.9	1845.0	435.8	0.0	1845.0	435.8	167.9
1845.0	435.8	335.8	1845.0	-317.2	335.8	1845.0	-156.8	335.8
1845.0	3.5	335.8	1845.0	163.9	335.8	1845.0	324.3	335.8
1845.0	-317.2	-335.8	1845.0	-156.8	-335.8	1845.0	3.5	-335.8
1845.0	163.9	-335.8	1845.0	324.3	-335.8	1230.0	-317.2	-167.9
1230.0	-156.8	-167.9	1230.0	3.5	-167.9	1230.0	163.9	-167.9
1230.0	324.3	-167.9	1230.0	-317.2	167.9	1230.0	-156.8	167.9
1230.0	3.5	167.9	1230.0	163.9	167.9	1230.0	324.3	167.9

5. Factored Loads and Moments with Corresponding Capacity Ratios

NOTE: Calculations are based on "Critical Capacity" Method.

No.	Demand			Capacity			Parameters at Capacity			Capacity Ratio
	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	NA Depth mm	ε_t	ϕ	
1	2830.00	277.00	10.00	10087.49	3673.35	132.61	520	0.00139	0.650	0.27
2	21970.00	48.00	19.00	21516.62	48.00	19.00	1014	-0.00028	0.650	1.02 #
3	8884.00	696.00	114.00	15532.95	2813.17	460.78	726	0.00050	0.650	0.46
4	19339.00	412.00	22.00	21516.62	412.00	22.00	896	-0.00047	0.650	0.90
5	19240.00	400.00	398.00	21516.62	400.00	398.00	1180	-0.00015	0.650	0.89
6	8060.00	244.00	224.00	21516.62	244.00	224.00	1166	-0.00015	0.650	0.37

Section capacity exceeded. Revise design!

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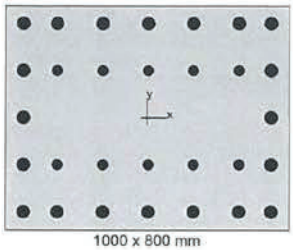
6. Diagrams

6.1. PM at θ=22 [deg]



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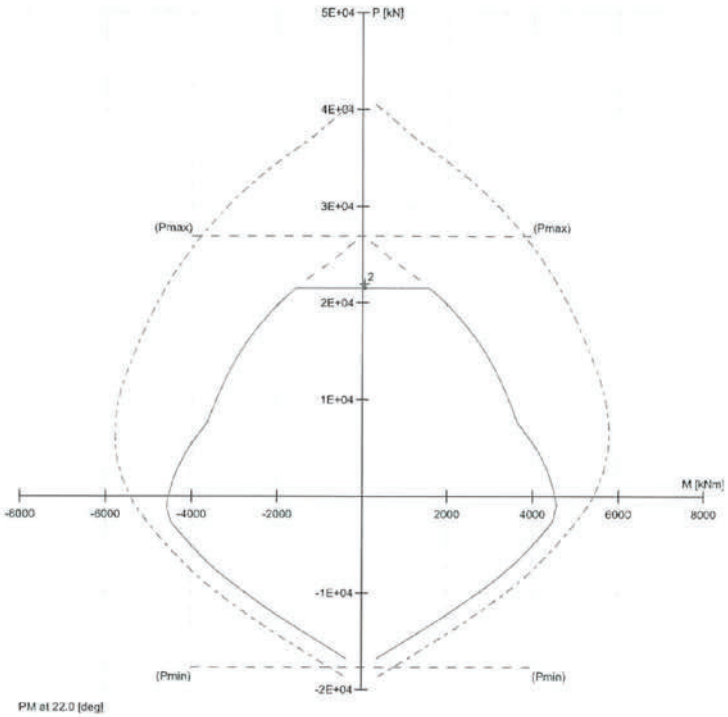

General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials	
f'_c	34 MPa
E_c	27405.5 MPa
f_y	400 MPa
E_s	200000 MPa

Section	
Type	Irregular
A_g	800000 mm²
I_x	4.26667e+010 mm⁴
I_y	6.66667e+010 mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	49200 mm²
Rho	6.15 %
Min. clear spacing	63 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
2	21970.0	48.0	19.0	21516.62	48.00	19.00	1.02

Max. Capacity Ratio: 1.02

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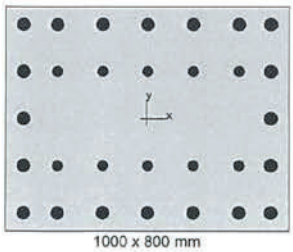
6.2. MM at P=21970 [kN]



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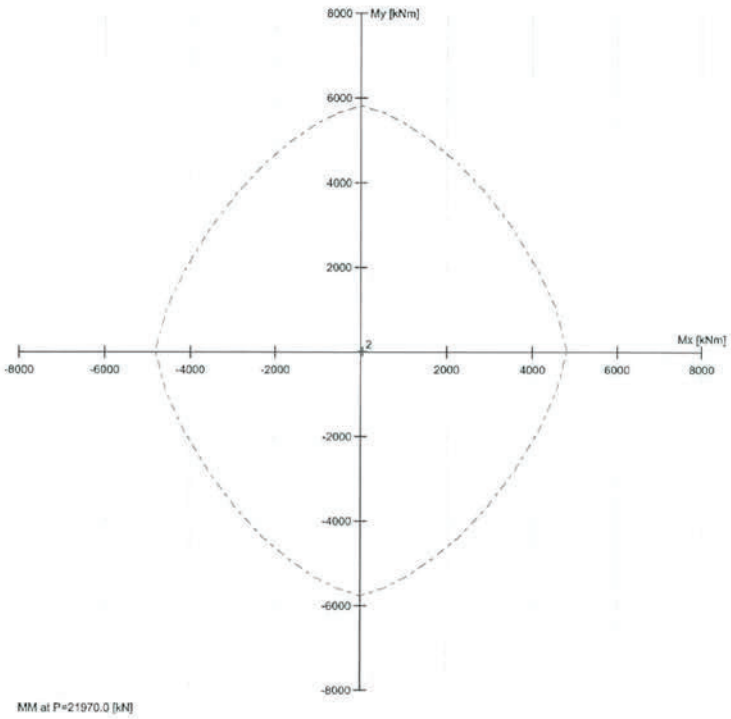

General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials	
f'_c	34 MPa
E_c	27405.5 MPa
f_y	400 MPa
E_s	200000 MPa

Section	
Type	Irregular
A_g	800000 mm²
I_x	4.26667e+010 mm⁴
I_y	6.66667e+010 mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	49200 mm²
Rho	6.15 %
Min. clear spacing	63 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
2	21970.0	48.0	19.0	21516.62	48.00	19.00	1.02

Max. Capacity Ratio: 1.02

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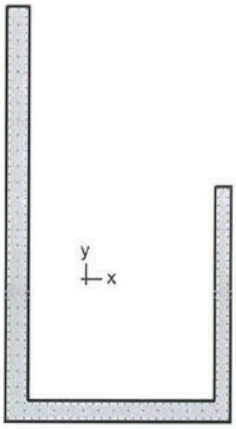
spColumn

spColumn v6.50
Computer program for the Strength Design of Reinforced Concrete Sections



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REGISTERED PROFESSIONAL ENGINEER

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1. General Information

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Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

2. Material Properties

2.1. Concrete

Type	Standard	
f'_c	35	MPa
E_c	27805.6	MPa
f_c	29.75	MPa
ε_u	0.003	mm/mm
β_1	0.796192	

2.2. Steel

Type	Standard	
f_y	400	MPa
E_s	200000	MPa
ε_{yt}	0.002	mm/mm

3. Section

3.1. Shape and Properties

Type	Irregular	
A_g	6.07125e+006	mm^2
I_x	3.34113e+013	mm^4
I_y	1.65083e+013	mm^4
r_x	2345.89	mm
r_y	1648.97	mm
X_o	0	mm
Y_o	-0.000168664	mm

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3.2. Section Figure

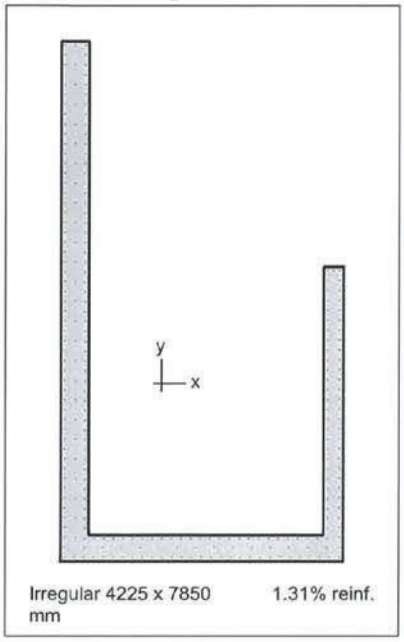

Figure 1: Column section

3.3. Exterior Points

Points	X mm	Y mm	Points	X mm	Y mm	Points	X mm	Y mm
1	2710.6	1757.8	2	2410.6	1757.8	3	2410.6	-2292.2
4	-1089.4	-2292.2	5	-1089.4	5157.8	6	-1514.4	5157.8
7	-1514.4	-2692.2	8	2710.6	-2692.2			

4. Reinforcement

4.1. Bar Set: ASTM A615

Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²
#3	9.53	70.97	#4	12.70	129.03	#5	15.88	200.00
#6	19.05	283.87	#7	22.23	387.10	#8	25.40	509.68
#9	28.65	645.16	#10	32.26	819.35	#11	35.81	1006.45
#14	43.00	1451.61	#18	57.33	2580.64			

4.2. Confinement and Factors

Confinement type	Tied
For #10 bars or less	#3 ties
For larger bars	#4 ties
Capacity Reduction Factors	
Axial compression, (a)	0.8
Tension controlled ϕ, (b)	0.9
Compression controlled ϕ, (c)	0.65

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4.3. Arrangement

Pattern	Irregular
Bar layout	---

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Cover to	---	
Clear cover	---	
Bars	---	
Total steel area, A_s	79756	mm²
Rho	1.31	%
Minimum clear spacing	70	mm

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4.4. Bars Provided

Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
314.0	-1454.4	-2632.2	314.0	-1454.4	-2483.6	314.0	-1454.4	-2334.9
314.0	-1454.4	-2186.3	314.0	-1454.4	-2037.6	314.0	-1454.4	-1889.0
314.0	-1454.4	-1740.3	314.0	-1454.4	-1591.6	314.0	-1454.4	-1443.0
314.0	-1454.4	-1294.3	314.0	-1454.4	-1145.7	314.0	-1454.4	-997.0
314.0	-1454.4	-848.4	314.0	-1454.4	-699.7	314.0	-1454.4	-551.1
314.0	-1454.4	-402.4	314.0	-1454.4	-253.8	314.0	-1454.4	-105.1
314.0	-1454.4	43.5	314.0	-1454.4	192.2	314.0	-1454.4	340.9
314.0	-1454.4	489.5	314.0	-1454.4	638.2	314.0	-1454.4	786.8
314.0	-1454.4	935.5	314.0	-1454.4	1084.1	314.0	-1454.4	1232.8
314.0	-1454.4	1381.4	314.0	-1454.4	1530.1	314.0	-1454.4	1678.7
314.0	-1454.4	1827.4	314.0	-1454.4	1976.0	314.0	-1454.4	2124.7
314.0	-1454.4	2273.4	314.0	-1454.4	2422.0	314.0	-1454.4	2570.7
314.0	-1454.4	2719.3	314.0	-1454.4	2868.0	314.0	-1454.4	3016.6
314.0	-1454.4	3165.3	314.0	-1454.4	3313.9	314.0	-1454.4	3462.6
314.0	-1454.4	3611.2	314.0	-1454.4	3759.9	314.0	-1454.4	3908.5
314.0	-1454.4	4057.2	314.0	-1454.4	4205.9	314.0	-1454.4	4354.5
314.0	-1454.4	4503.2	314.0	-1454.4	4651.8	314.0	-1454.4	4800.5
314.0	-1454.4	4949.1	314.0	-1454.4	5097.8	314.0	-1307.8	-2632.2
314.0	-1161.2	-2632.2	314.0	-1149.4	-2352.2	314.0	-1149.4	-2203.2
314.0	-1149.4	-2054.2	314.0	-1149.4	-1905.2	314.0	-1149.4	-1756.2
314.0	-1149.4	-1607.2	314.0	-1149.4	-1458.2	314.0	-1149.4	-1309.2
314.0	-1149.4	-1160.2	314.0	-1149.4	-1011.2	314.0	-1149.4	-862.2
314.0	-1149.4	-713.2	314.0	-1149.4	-564.2	314.0	-1149.4	-415.2
314.0	-1149.4	-266.2	314.0	-1149.4	-117.2	314.0	-1149.4	31.8
314.0	-1149.4	180.8	314.0	-1149.4	329.8	314.0	-1149.4	478.8
314.0	-1149.4	627.8	314.0	-1149.4	776.8	314.0	-1149.4	925.8
314.0	-1149.4	1074.8	314.0	-1149.4	1223.8	314.0	-1149.4	1372.8
314.0	-1149.4	1521.8	314.0	-1149.4	1670.8	314.0	-1149.4	1819.8
314.0	-1149.4	1968.8	314.0	-1149.4	2117.8	314.0	-1149.4	2266.8
314.0	-1149.4	2415.8	314.0	-1149.4	2564.8	314.0	-1149.4	2713.8
314.0	-1149.4	2862.8	314.0	-1149.4	3011.8	314.0	-1149.4	3160.8
314.0	-1149.4	3309.8	314.0	-1149.4	3458.8	314.0	-1149.4	3607.8
314.0	-1149.4	3756.8	314.0	-1149.4	3905.8	314.0	-1149.4	4054.8
314.0	-1149.4	4203.8	314.0	-1149.4	4352.8	314.0	-1149.4	4501.8
314.0	-1149.4	4650.8	314.0	-1149.4	4799.8	314.0	-1149.4	4948.8
314.0	-1149.4	5097.8	314.0	-1014.5	-2632.2	314.0	-1004.6	-2352.2
314.0	-867.9	-2632.2	314.0	-859.8	-2352.2	314.0	-721.3	-2632.2
314.0	-715.0	-2352.2	314.0	-574.7	-2632.2	314.0	-570.2	-2352.2
314.0	-428.1	-2632.2	314.0	-425.4	-2352.2	314.0	-281.5	-2632.2
314.0	-280.6	-2352.2	314.0	-135.8	-2352.2	314.0	-134.9	-2632.2
314.0	9.0	-2352.2	314.0	11.7	-2632.2	314.0	153.8	-2352.2
314.0	158.3	-2632.2	314.0	298.6	-2352.2	314.0	304.9	-2632.2
314.0	443.4	-2352.2	314.0	451.5	-2632.2	314.0	588.2	-2352.2
314.0	598.1	-2632.2	314.0	733.0	-2352.2	314.0	744.7	-2632.2
314.0	877.8	-2352.2	314.0	891.4	-2632.2	314.0	1022.6	-2352.2
314.0	1038.0	-2632.2	314.0	1167.4	-2352.2	314.0	1184.6	-2632.2
314.0	1312.2	-2352.2	314.0	1331.2	-2632.2	314.0	1457.0	-2352.2
314.0	1477.8	-2632.2	314.0	1601.8	-2352.2	314.0	1624.4	-2632.2
314.0	1746.6	-2352.2	314.0	1771.0	-2632.2	314.0	1891.4	-2352.2

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Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
314.0	1917.6	-2632.2	314.0	2036.2	-2352.2	314.0	2064.2	-2632.2
314.0	2181.0	-2352.2	314.0	2210.8	-2632.2	314.0	2325.8	-2352.2
314.0	2357.4	-2632.2	314.0	2470.6	-2352.2	314.0	2470.6	-2202.2
314.0	2470.6	-2052.2	314.0	2470.6	-1902.2	314.0	2470.6	-1752.2
314.0	2470.6	-1602.2	314.0	2470.6	-1452.2	314.0	2470.6	-1302.2
314.0	2470.6	-1152.2	314.0	2470.6	-1002.2	314.0	2470.6	-852.2
314.0	2470.6	-702.2	314.0	2470.6	-552.2	314.0	2470.6	-402.2
314.0	2470.6	-252.2	314.0	2470.6	-102.2	314.0	2470.6	47.8
314.0	2470.6	197.8	314.0	2470.6	347.8	314.0	2470.6	497.8
314.0	2470.6	647.8	314.0	2470.6	797.8	314.0	2470.6	947.8
314.0	2470.6	1097.8	314.0	2470.6	1247.8	314.0	2470.6	1397.8
314.0	2470.6	1547.8	314.0	2470.6	1697.8	314.0	2504.0	-2632.2
314.0	2560.6	1697.8	314.0	2650.6	-2632.2	314.0	2650.6	-2482.9
314.0	2650.6	-2333.6	314.0	2650.6	-2184.3	314.0	2650.6	-2035.0
314.0	2650.6	-1885.7	314.0	2650.6	-1736.4	314.0	2650.6	-1587.1
314.0	2650.6	-1437.7	314.0	2650.6	-1288.4	314.0	2650.6	-1139.1
314.0	2650.6	-989.8	314.0	2650.6	-840.5	314.0	2650.6	-691.2
314.0	2650.6	-541.9	314.0	2650.6	-392.6	314.0	2650.6	-243.3
314.0	2650.6	-93.9	314.0	2650.6	55.4	314.0	2650.6	204.7
314.0	2650.6	354.0	314.0	2650.6	503.3	314.0	2650.6	652.6
314.0	2650.6	801.9	314.0	2650.6	951.2	314.0	2650.6	1100.5
314.0	2650.6	1249.8	314.0	2650.6	1399.2	314.0	2650.6	1548.5
314.0	2650.6	1697.8	314.0	-1301.9	5097.8	314.0	-1301.1	4800.5
314.0	-1300.3	4503.1	314.0	-1299.6	4205.8	314.0	-1298.8	3908.5
314.0	-1298.0	3611.2	314.0	-1297.3	3313.9	314.0	-1296.5	3016.5
314.0	-1295.7	2719.2	314.0	-1295.0	2421.9	314.0	-1294.2	2124.6
314.0	-1293.5	1827.3	314.0	-1292.7	1529.9	314.0	-1291.9	1232.6
314.0	-1291.2	935.3	314.0	-1290.4	638.0	314.0	-1289.6	340.7
314.0	-1288.9	43.3	314.0	-1288.1	-254.0	314.0	-1287.3	-551.3
314.0	-1286.6	-848.6	314.0	-1285.8	-1145.9	314.0	-1285.0	-1443.3
314.0	-1284.3	-1740.6	314.0	-1283.5	-2037.9	314.0	-1282.7	-2335.2
314.0	-1152.3	-2485.8	314.0	-873.9	-2485.6	314.0	-595.5	-2485.5
314.0	-317.1	-2485.3	314.0	-38.8	-2485.1	314.0	239.6	-2485.0
314.0	518.0	-2484.8	314.0	796.4	-2484.7	314.0	1074.7	-2484.5
314.0	1353.1	-2484.4	314.0	1631.5	-2484.2	314.0	1909.9	-2484.1
314.0	2188.3	-2483.9	314.0	2466.6	-2483.8			

5. Factored Loads and Moments with Corresponding Capacity Ratios

NOTE: Calculations are based on "Critical Capacity" Method.

No.	Demand			Capacity			Parameters at Capacity			Capacity Ratio
	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	NA Depth mm	ε_t	ϕ	
1	9030.00	30340.00	1740.00	0.00	72252.30	4143.67	368	0.07756	0.900	0.77
2	42480.00	8270.00	10500.00	0.00	52827.01	67071.79	1017	0.01734	0.900	0.45
3	29800.00	73740.00	440.00	10337.97	96705.86	577.03	599	0.04367	0.900	0.78
4	26440.00	8240.00	20520.00	0.00	28637.41	71315.48	458	0.03759	0.900	0.58
5	35250.00	32520.00	38980.00	1106.91	57002.45	68325.82	1129	0.01637	0.900	0.63
6	30500.00	95750.00	3430.00	17109.35	112881.09	4043.68	694	0.03609	0.900	0.85

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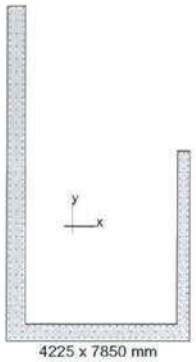
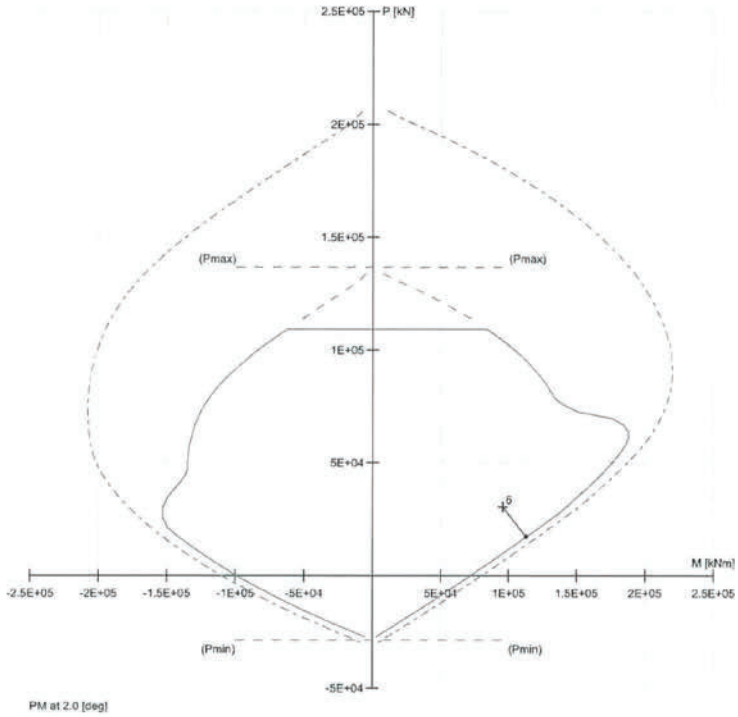
6. Diagrams

6.1. PM at θ=2 [deg]





General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials	
f'_c	35 MPa
E_c	27805.6 MPa
f_y	400 MPa
E_s	200000 MPa

Section	
Type	Irregular
A_g	6.07125e+006 mm²
I_x	3.34113e+013 mm⁴
I_y	1.65083e+013 mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	79756 mm²
Rho	1.31 %
Min. clear spacing	70 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
6	30500.0	95750.0	3430.0	17109.35	112881.09	4043.68	0.85

Max. Capacity Ratio: 0.85

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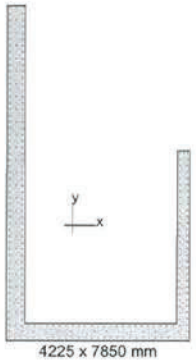
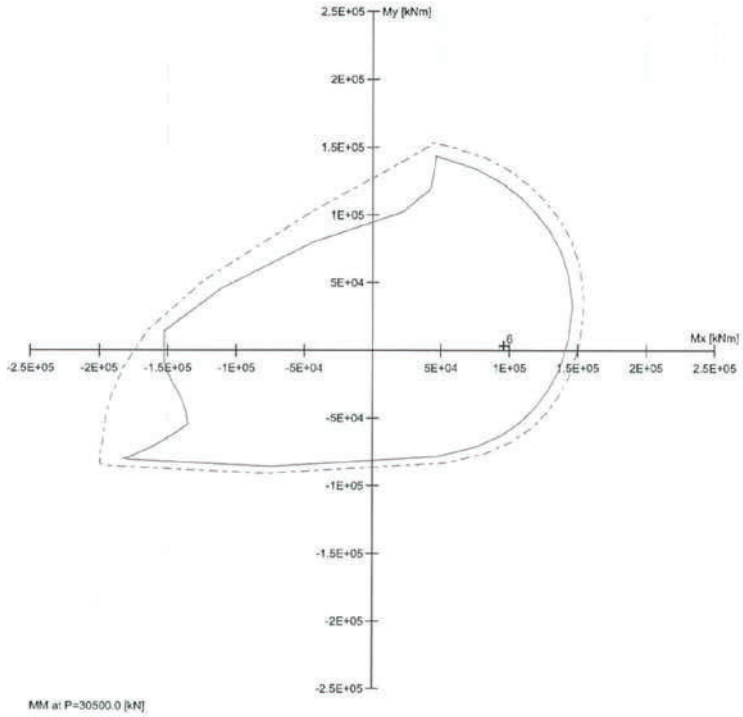
6.2. MM at P=30500 [kN]





General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials		
f'_c	35	MPa
E_c	27805.6	MPa
f_y	400	MPa
E_s	200000	MPa

Section		
Type	Irregular	
A_g	6.07125e+006	mm^2
I_x	3.34113e+013	mm^4
I_y	1.65083e+013	mm^4

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	79756 mm^2
Rho	1.31 %
Min. clear spacing	70 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
6	30500.0	95750.0	3430.0	17109.35	112881.09	4043.68	0.85

Max. Capacity Ratio: 0.85

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spColumn

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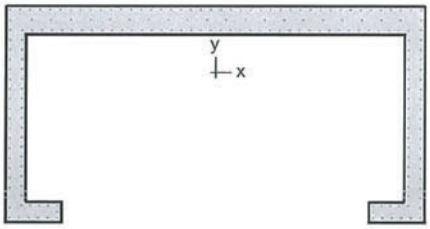
Computer program for the Strength Design of Reinforced Concrete Sections



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StructurePoint

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1. General Information

File Name	C:\193018\GCDT\SPcloumn\10-09-63(C1 ...\P2-L2.col
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

2. Material Properties

2.1. Concrete

Type	Standard	
f'_c	35	MPa
E_c	27805.6	MPa
f_c	29.75	MPa
ε_u	0.003	mm/mm
β_1	0.796192	

2.2. Steel

Type	Standard	
f_y	400	MPa
E_s	200000	MPa
ε_{yt}	0.002	mm/mm

3. Section

3.1. Shape and Properties

Type	Irregular	
A_g	4.63e+006	mm^2
I_x	5.27319e+012	mm^4
I_y	2.51091e+013	mm^4
r_x	1067.2	mm
r_y	2328.76	mm
X_o	0	mm
Y_o	0	mm

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3.2. Section Figure

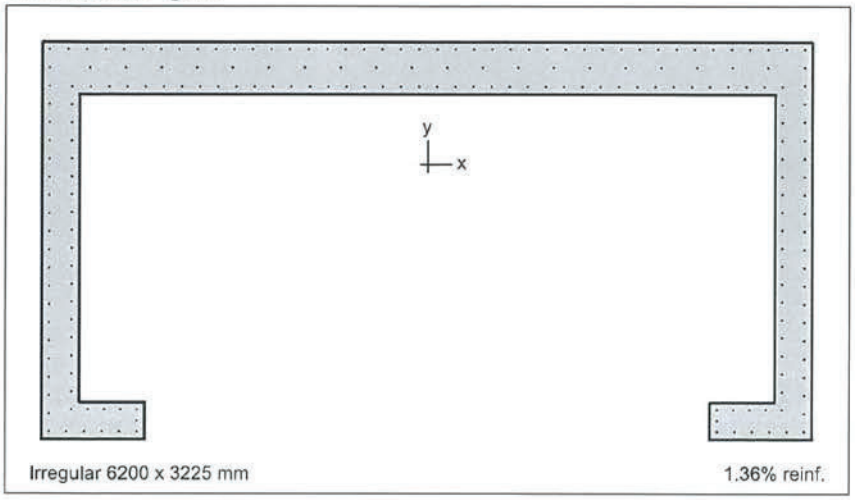

Figure 1: Column section

3.3. Exterior Points

Points	X mm	Y mm	Points	X mm	Y mm	Points	X mm	Y mm
1	-2275.0	-1932.7	2	-2800.0	-1932.7	3	-2800.0	567.3
4	2800.0	567.3	5	2800.0	-1932.7	6	2275.0	-1932.7
7	2275.0	-2232.7	8	3100.0	-2232.7	9	3100.0	992.3
10	-3100.0	992.3	11	-3100.0	-2232.7	12	-2275.0	-2232.7

4. Reinforcement

4.1. Bar Set: ASTM A615

Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²
#3	9.53	70.97	#4	12.70	129.03	#5	15.88	200.00
#6	19.05	283.87	#7	22.23	387.10	#8	25.40	509.68
#9	28.65	645.16	#10	32.26	819.35	#11	35.81	1006.45
#14	43.00	1451.61	#18	57.33	2580.64			

4.2. Confinement and Factors

Confinement type	Tied
For #10 bars or less	#3 ties
For larger bars	#4 ties
Capacity Reduction Factors	
Axial compression, (a)	0.8
Tension controlled ϕ, (b)	0.9
Compression controlled ϕ, (c)	0.65

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4.3. Arrangement

Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---

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Total steel area, A_s	62800	mm²
Rho	1.36	%
Minimum clear spacing	70	mm

4.4. Bars Provided

Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
314.0	-3040.0	932.3	314.0	-2899.6	-2172.7	314.0	-2891.7	932.3
314.0	-2860.0	-1992.7	314.0	-2860.0	-1847.1	314.0	-2860.0	-1701.5
314.0	-2860.0	-1556.0	314.0	-2860.0	-1410.4	314.0	-2860.0	-1264.9
314.0	-2860.0	-1119.3	314.0	-2860.0	-973.8	314.0	-2860.0	-828.2
314.0	-2860.0	-682.7	314.0	-2860.0	-537.1	314.0	-2860.0	-391.5
314.0	-2860.0	-246.0	314.0	-2860.0	-100.4	314.0	-2860.0	45.1
314.0	-2860.0	190.7	314.0	-2860.0	336.2	314.0	-2860.0	481.8
314.0	-2860.0	627.3	314.0	-2759.2	-2172.7	314.0	-2743.4	932.3
314.0	-2729.5	-1992.7	314.0	-2713.3	627.3	314.0	-2618.8	-2172.7
314.0	-2599.0	-1992.7	314.0	-2595.1	932.3	314.0	-2566.7	627.3
314.0	-2478.4	-2172.7	314.0	-2468.5	-1992.7	314.0	-2446.8	932.3
314.0	-2420.0	627.3	314.0	-2338.0	-2172.7	314.0	-2338.0	-2082.7
314.0	-2338.0	-1992.7	314.0	-2298.5	932.3	314.0	-2273.3	627.3
314.0	-2150.2	932.3	314.0	-2126.7	627.3	314.0	-2002.0	932.3
314.0	-1980.0	627.3	314.0	-1853.7	932.3	314.0	-1833.3	627.3
314.0	-1705.4	932.3	314.0	-1686.7	627.3	314.0	-1557.1	932.3
314.0	-1540.0	627.3	314.0	-1408.8	932.3	314.0	-1393.3	627.3
314.0	-1260.5	932.3	314.0	-1246.7	627.3	314.0	-1112.2	932.3
314.0	-1100.0	627.3	314.0	-963.9	932.3	314.0	-953.3	627.3
314.0	-815.6	932.3	314.0	-806.7	627.3	314.0	-667.3	932.3
314.0	-660.0	627.3	314.0	-519.0	932.3	314.0	-513.3	627.3
314.0	-370.7	932.3	314.0	-366.7	627.3	314.0	-222.4	932.3
314.0	-220.0	627.3	314.0	-74.1	932.3	314.0	-73.3	627.3
314.0	73.3	627.3	314.0	74.1	932.3	314.0	220.0	627.3
314.0	222.4	932.3	314.0	366.7	627.3	314.0	370.7	932.3
314.0	513.3	627.3	314.0	519.0	932.3	314.0	660.0	627.3
314.0	667.3	932.3	314.0	806.7	627.3	314.0	815.6	932.3
314.0	953.3	627.3	314.0	963.9	932.3	314.0	1100.0	627.3
314.0	1112.2	932.3	314.0	1246.7	627.3	314.0	1260.5	932.3
314.0	1393.3	627.3	314.0	1408.8	932.3	314.0	1540.0	627.3
314.0	1557.1	932.3	314.0	1686.7	627.3	314.0	1705.4	932.3
314.0	1833.3	627.3	314.0	1853.7	932.3	314.0	1980.0	627.3
314.0	2002.0	932.3	314.0	2126.7	627.3	314.0	2150.2	932.3
314.0	2273.3	627.3	314.0	2298.5	932.3	314.0	2335.0	-2172.7
314.0	2335.0	-2082.7	314.0	2335.0	-1992.7	314.0	2420.0	627.3
314.0	2446.8	932.3	314.0	2466.2	-1992.7	314.0	2476.0	-2172.7
314.0	2566.7	627.3	314.0	2595.1	932.3	314.0	2597.5	-1992.7
314.0	2617.0	-2172.7	314.0	2713.3	627.3	314.0	2728.7	-1992.7
314.0	2743.4	932.3	314.0	2758.0	-2172.7	314.0	2860.0	-1992.7
314.0	2860.0	-1847.1	314.0	2860.0	-1701.5	314.0	2860.0	-1556.0
314.0	2860.0	-1410.4	314.0	2860.0	-1264.9	314.0	2860.0	-1119.3
314.0	2860.0	-973.8	314.0	2860.0	-828.2	314.0	2860.0	-682.7
314.0	2860.0	-537.1	314.0	2860.0	-391.5	314.0	2860.0	-246.0
314.0	2860.0	-100.4	314.0	2860.0	45.1	314.0	2860.0	190.7
314.0	2860.0	336.2	314.0	2860.0	481.8	314.0	2860.0	627.3
314.0	2891.7	932.3	314.0	2899.0	-2172.7	314.0	3040.0	-2172.7
314.0	3040.0	-2024.8	314.0	3040.0	-1876.9	314.0	3040.0	-1729.1
314.0	3040.0	-1581.2	314.0	3040.0	-1433.4	314.0	3040.0	-1285.5
314.0	3040.0	-1137.7	314.0	3040.0	-989.8	314.0	3040.0	-841.9
314.0	3040.0	-694.1	314.0	3040.0	-546.2	314.0	3040.0	-398.4
314.0	3040.0	-250.5	314.0	3040.0	-102.7	314.0	3040.0	45.2
314.0	3040.0	193.1	314.0	3040.0	340.9	314.0	3040.0	488.8
314.0	3040.0	636.6	314.0	3040.0	784.5	314.0	3040.0	932.3

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Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
314.0	-3040.0	-548.7	314.0	-3040.0	-401.1	314.0	-3040.0	-253.5
314.0	-3040.0	-105.9	314.0	-3040.0	41.8	314.0	-3040.0	189.4
314.0	-3040.0	337.0	314.0	-3040.0	484.7	314.0	-3040.0	632.3
314.0	-3040.0	779.9	314.0	-3040.0	-2172.7	314.0	-3040.0	-2025.0
314.0	-3040.0	-1877.4	314.0	-3040.0	-1729.8	314.0	-3040.0	-1582.1
314.0	-3040.0	-1434.5	314.0	-3040.0	-1286.9	314.0	-3040.0	-1139.3
314.0	-3040.0	-991.6	314.0	-3040.0	-844.0	314.0	-3040.0	-696.4
314.0	-2719.0	784.3	314.0	-2431.6	784.2	314.0	-2144.2	784.1
314.0	-1856.7	784.0	314.0	-1569.3	783.9	314.0	-1281.9	783.9
314.0	-994.5	783.8	314.0	-707.1	783.7	314.0	-419.6	783.6
314.0	-132.2	783.5	314.0	155.2	783.4	314.0	442.6	783.3
314.0	730.1	783.2	314.0	1017.5	783.1	314.0	1304.9	783.0
314.0	1592.3	782.9	314.0	1879.7	782.8	314.0	2167.2	782.7
314.0	2454.6	782.6	314.0	2742.0	782.5			

5. Factored Loads and Moments with Corresponding Capacity Ratios

NOTE: Calculations are based on "Critical Capacity" Method.

No.	Demand			Capacity			Parameters at Capacity			Capacity Ratio
	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	NA Depth mm	ε_t	ϕ	
1	5670.00	5780.00	9050.00	0.00	36078.04	56488.96	1575	0.00640	0.900	0.42
2	28110.00	2530.00	29960.00	352.32	5762.16	68234.85	385	0.05637	0.900	0.60
3	21820.00	3090.00	32270.00	0.00	6444.59	67303.22	359	0.06016	0.900	0.66
4	19740.00	13680.00	27170.00	21356.38	32473.49	64495.96	3216	0.00205	0.655	0.61
5	20290.00	18650.00	25180.00	22610.27	38524.69	52013.50	3114	0.00193	0.650	0.64
6	22930.00	7660.00	97520.00	15392.19	8593.18	109400.34	892	0.01953	0.900	0.88

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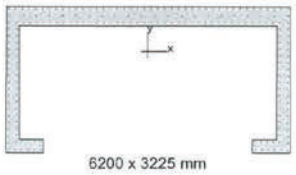
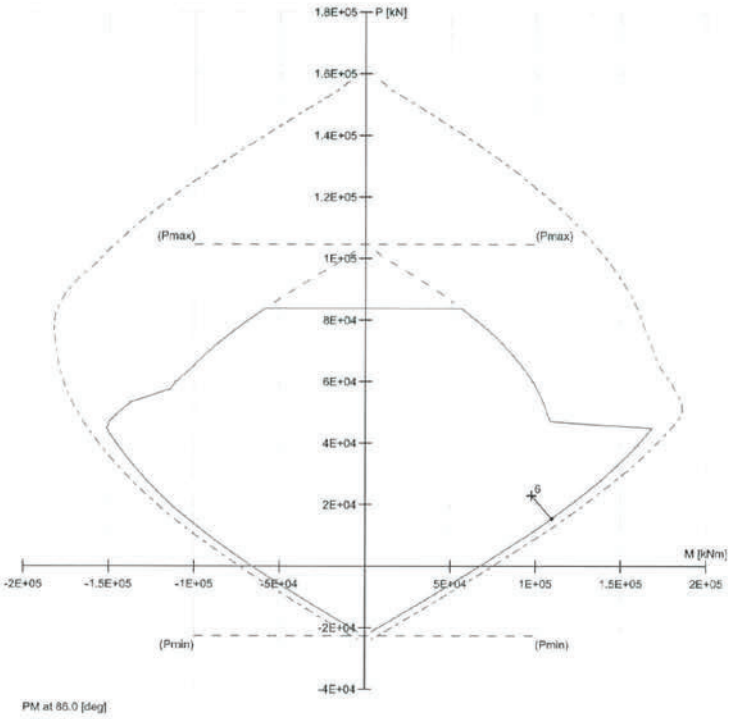
6. Diagrams

6.1. PM at θ=86 [deg]





General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials	
f'_c	35 MPa
E_c	27805.6 MPa
f_y	400 MPa
E_s	200000 MPa

Section	
Type	Irregular
A_g	4.63e+006 mm²
I_x	5.27319e+012 mm⁴
I_y	2.51091e+013 mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	62800 mm²
Rho	1.36 %
Min. clear spacing	70 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
6	22930.0	7660.0	97520.0	15392.19	8593.18	109400.34	0.88

Max. Capacity Ratio: 0.88

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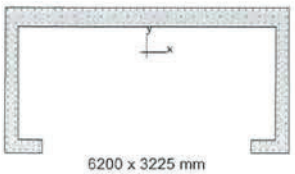
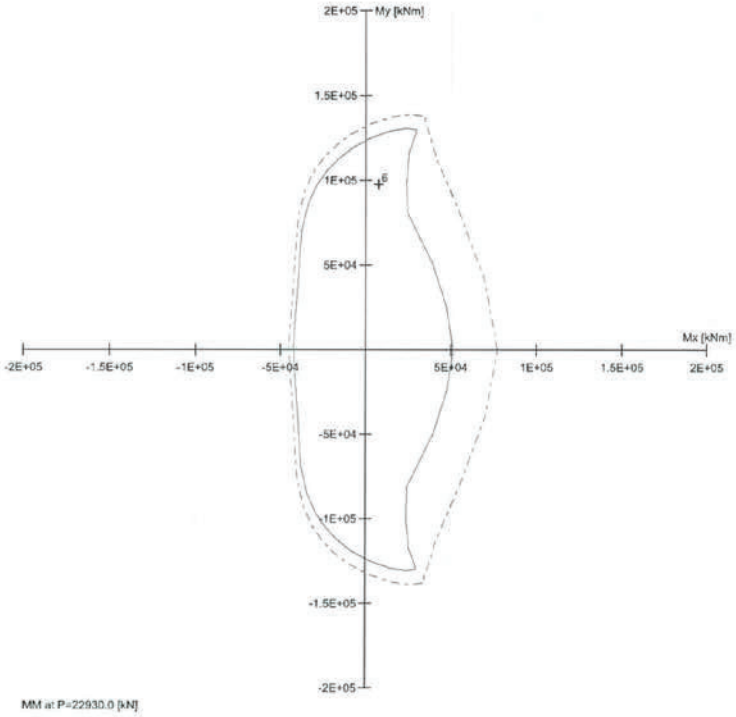
6.2. MM at P=22930 [kN]



6200 x 3225 mm



General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials		
f'_c	35	MPa
E_c	27805.6	MPa
f_y	400	MPa
E_s	200000	MPa

Section		
Type	Irregular	
A_g	4.63e+006	mm²
I_x	5.27319e+012	mm⁴
I_y	2.51091e+013	mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	62800 mm²
Rho	1.36 %
Min. clear spacing	70 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
6	22930.0	7660.0	97520.0	15392.19	8593.18	109400.34	0.88

Max. Capacity Ratio: 0.88

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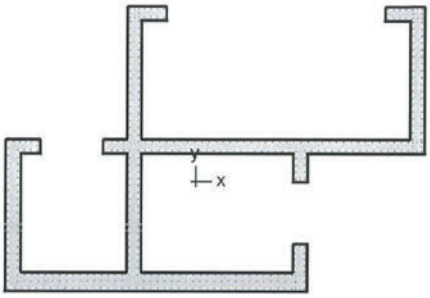
spColumn

spColumn v6.50
Computer program for the Strength Design of Reinforced Concrete Sections



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1. General Information

File Name	C:\193018\GCDT\SPcloumn\10-09-63(C1 ...\P3-L2.col
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

2. Material Properties

2.1. Concrete

Type	Standard	
f'_c	35	MPa
E_c	27805.6	MPa
f_c	29.75	MPa
ε_u	0.003	mm/mm
β_1	0.796192	

2.2. Steel

Type	Standard	
f_y	400	MPa
E_s	200000	MPa
ε_{yt}	0.002	mm/mm

3. Section

3.1. Shape and Properties

Type	Irregular	
A_g	8.6825e+006	mm^2
I_x	2.8376e+013	mm^4
I_y	6.17429e+013	mm^4
r_x	1807.81	mm
r_y	2666.68	mm
X_o	-0.000117938	mm
Y_o	-0.000235877	mm

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3.2. Section Figure

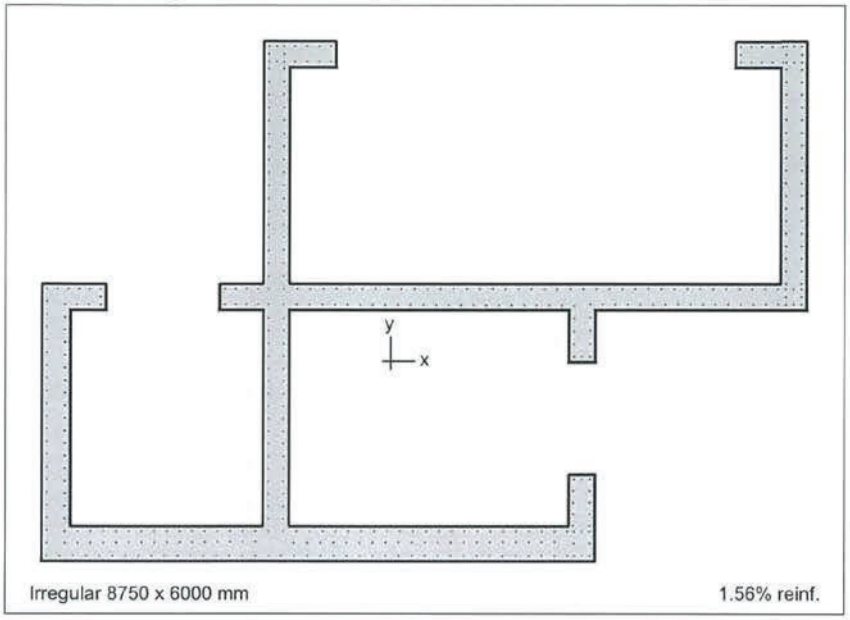

Figure 1: Column section

3.3. Exterior Points

Points	X mm	Y mm	Points	X mm	Y mm	Points	X mm	Y mm
1	2344.9	-1310.9	2	2044.9	-1310.9	3	2044.9	-1910.9
4	-1155.1	-1910.9	5	-1155.1	589.1	6	2044.9	589.1
7	2044.9	-10.9	8	2344.9	-10.9	9	2344.9	589.1
10	4769.9	589.1	11	4769.9	3689.1	12	4469.9	3689.1
13	4469.9	3683.1	14	3944.9	3683.1	15	3944.9	3383.1
16	4469.9	3383.1	17	4469.9	889.1	18	-1155.1	889.1
19	-1155.1	3389.1	20	-630.1	3389.1	21	-630.1	3689.1
22	-1455.1	3689.1	23	-1455.1	889.1	24	-1955.1	889.1
25	-1955.1	589.1	26	-1455.1	589.1	27	-1455.1	-1910.9
28	-3655.1	-1910.9	29	-3655.1	589.1	30	-3255.1	589.1
31	-3255.1	889.1	32	-3980.1	889.1	33	-3980.1	-2310.9
34	2344.9	-2310.9						

4. Reinforcement

4.1. Bar Set: ASTM A615

Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²
#3	9.53	70.97	#4	12.70	129.03	#5	15.88	200.00
#6	19.05	283.87	#7	22.23	387.10	#8	25.40	509.68
#9	28.65	645.16	#10	32.26	819.35	#11	35.81	1006.45
#14	43.00	1451.61	#18	57.33	2580.64			

4.2. Confinement and Factors

Confinement type	Tied
For #10 bars or less	#3 ties
For larger bars	#4 ties
Capacity Reduction Factors	
Axial compression, (a)	0.8

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Tension controlled ϕ, (b)	0.9
Compression controlled ϕ, (c)	0.65

4.3. Arrangement

Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Total steel area, A_s	135020 mm²
Rho	1.56 %
Minimum clear spacing	18 mm

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4.4. Bars Provided

Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
314.0	-1395.1	3629.1	314.0	-1305.1	3629.1	314.0	-1215.1	3629.1
314.0	-1215.1	3539.1	314.0	-1215.1	3449.1	314.0	-1305.1	3449.1
314.0	-1395.1	3449.1	314.0	-1395.1	3539.1	314.0	4709.9	3629.1
314.0	4619.9	3629.1	314.0	4529.9	3629.1	314.0	4529.9	3536.1
314.0	4529.9	3443.1	314.0	4619.9	3443.1	314.0	4709.9	3443.1
314.0	4709.9	3536.1	314.0	4709.9	649.1	314.0	4619.9	649.1
314.0	4529.9	649.1	314.0	4529.9	739.1	314.0	4529.9	829.1
314.0	4619.9	829.1	314.0	4709.9	829.1	314.0	4709.9	739.1
314.0	2104.9	-1970.9	314.0	2194.9	-1970.9	314.0	2284.9	-1970.9
314.0	2284.9	-2110.9	314.0	2284.9	-2250.9	314.0	2194.9	-2250.9
314.0	2104.9	-2250.9	314.0	2104.9	-2110.9	314.0	2104.9	-1370.9
314.0	2194.9	-1370.9	314.0	2284.9	-1504.4	314.0	2284.9	-1370.9
314.0	2284.9	-1904.9	314.0	2284.9	-1771.4	314.0	2284.9	-1637.9
314.0	2094.9	-1504.4	314.0	2094.9	-1904.9	314.0	2094.9	-1771.4
314.0	2094.9	-1637.9	314.0	-3920.1	-2250.9	314.0	-3920.1	-2104.3
314.0	-3920.1	-1957.6	314.0	-3920.1	-1810.9	314.0	-3920.1	-1664.3
314.0	-3920.1	-1517.6	314.0	-3920.1	-1370.9	314.0	-3920.1	-1224.3
314.0	-3920.1	-1077.6	314.0	-3920.1	-930.9	314.0	-3920.1	-784.3
314.0	-3920.1	-637.6	314.0	-3920.1	-490.9	314.0	-3920.1	-344.3
314.0	-3920.1	-197.6	314.0	-3920.1	-50.9	314.0	-3920.1	95.7
314.0	-3920.1	242.4	314.0	-3920.1	389.1	314.0	-3920.1	535.7
314.0	-3920.1	682.4	314.0	-3920.1	829.1	314.0	-3799.1	829.1
314.0	-3771.3	-2250.9	314.0	-3715.1	-1970.9	314.0	-3715.1	-1825.4
314.0	-3715.1	-1679.8	314.0	-3715.1	-1534.3	314.0	-3715.1	-1388.7
314.0	-3715.1	-1243.2	314.0	-3715.1	-1097.6	314.0	-3715.1	-952.0
314.0	-3715.1	-806.5	314.0	-3715.1	-660.9	314.0	-3715.1	-515.4
314.0	-3715.1	-369.8	314.0	-3715.1	-224.3	314.0	-3715.1	-78.7
314.0	-3715.1	66.8	314.0	-3715.1	212.4	314.0	-3715.1	358.0
314.0	-3715.1	503.5	314.0	-3715.1	649.1	314.0	-3678.1	829.1
314.0	-3622.5	-2250.9	314.0	-3581.8	649.1	314.0	-3570.1	-1970.9
314.0	-3557.1	829.1	314.0	-3473.7	-2250.9	314.0	-3448.4	649.1
314.0	-3436.1	829.1	314.0	-3425.1	-1970.9	314.0	-3324.8	-2250.9
314.0	-3315.1	649.1	314.0	-3315.1	739.1	314.0	-3315.1	829.1
314.0	-3280.1	-1970.9	314.0	-3176.0	-2250.9	314.0	-3135.1	-1970.9
314.0	-3027.2	-2250.9	314.0	-2990.1	-1970.9	314.0	-2878.4	-2250.9
314.0	-2845.1	-1970.9	314.0	-2729.5	-2250.9	314.0	-2700.1	-1970.9
314.0	-2580.7	-2250.9	314.0	-2555.1	-1970.9	314.0	-2431.9	-2250.9
314.0	-2410.1	-1970.9	314.0	-2283.1	-2250.9	314.0	-2265.1	-1970.9
314.0	-2134.2	-2250.9	314.0	-2120.1	-1970.9	314.0	-1985.4	-2250.9
314.0	-1975.1	-1970.9	314.0	-1836.6	-2250.9	314.0	-1830.1	-1970.9
314.0	-1687.8	-2250.9	314.0	-1685.1	-1970.9	314.0	-1540.1	-1970.9

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Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
314.0	-1539.0	-2250.9	314.0	-1395.1	-1970.9	314.0	-1395.1	-1826.2
314.0	-1395.1	-1681.4	314.0	-1395.1	-1536.6	314.0	-1395.1	-1391.8
314.0	-1395.1	-1247.0	314.0	-1395.1	-1102.3	314.0	-1395.1	-957.5
314.0	-1395.1	-812.7	314.0	-1395.1	-667.9	314.0	-1395.1	-523.2
314.0	-1395.1	-378.4	314.0	-1395.1	-233.6	314.0	-1395.1	-88.8
314.0	-1395.1	56.0	314.0	-1395.1	200.7	314.0	-1395.1	345.5
314.0	-1395.1	490.3	314.0	-1390.1	-2250.9	314.0	-1241.3	-2250.9
314.0	-1215.1	490.3	314.0	-1215.1	345.5	314.0	-1215.1	200.7
314.0	-1215.1	56.0	314.0	-1215.1	-88.8	314.0	-1215.1	-233.6
314.0	-1215.1	-378.4	314.0	-1215.1	-523.2	314.0	-1215.1	-667.9
314.0	-1215.1	-812.7	314.0	-1215.1	-957.5	314.0	-1215.1	-1102.3
314.0	-1215.1	-1247.0	314.0	-1215.1	-1391.8	314.0	-1215.1	-1536.6
314.0	-1215.1	-1970.9	314.0	-1215.1	-1681.4	314.0	-1215.1	-1826.2
314.0	-1092.5	-2250.9	314.0	-1067.5	-1970.9	314.0	-943.7	-2250.9
314.0	-919.9	-1970.9	314.0	-794.8	-2250.9	314.0	-772.3	-1970.9
314.0	-646.0	-2250.9	314.0	-624.7	-1970.9	314.0	-497.2	-2250.9
314.0	-477.1	-1970.9	314.0	-348.4	-2250.9	314.0	-329.5	-1970.9
314.0	-199.6	-2250.9	314.0	-181.9	-1970.9	314.0	-50.7	-2250.9
314.0	-34.3	-1970.9	314.0	98.1	-2250.9	314.0	113.3	-1970.9
314.0	246.9	-2250.9	314.0	260.9	-1970.9	314.0	395.7	-2250.9
314.0	408.5	-1970.9	314.0	544.6	-2250.9	314.0	556.1	-1970.9
314.0	693.4	-2250.9	314.0	703.7	-1970.9	314.0	842.2	-2250.9
314.0	851.3	-1970.9	314.0	991.0	-2250.9	314.0	998.9	-1970.9
314.0	1139.8	-2250.9	314.0	1146.5	-1970.9	314.0	1288.7	-2250.9
314.0	1294.1	-1970.9	314.0	1437.5	-2250.9	314.0	1441.7	-1970.9
314.0	1586.3	-2250.9	314.0	1589.4	-1970.9	314.0	1735.1	-2250.9
314.0	1737.0	-1970.9	314.0	1884.0	-2250.9	314.0	1884.6	-1970.9
314.0	2032.2	-1970.9	314.0	2032.8	-2250.9	314.0	-1895.1	829.1
314.0	-1770.1	829.1	314.0	-1645.1	829.1	314.0	-1520.1	829.1
314.0	-1395.1	829.1	314.0	-1895.1	649.1	314.0	-1770.1	649.1
314.0	-1645.1	649.1	314.0	-1520.1	649.1	314.0	-1395.1	649.1
314.0	-1215.1	649.1	314.0	-1070.8	648.5	314.0	-926.4	647.8
314.0	-782.1	647.2	314.0	-637.7	646.6	314.0	-493.4	646.0
314.0	-349.0	645.4	314.0	-204.7	644.8	314.0	-60.3	644.2
314.0	84.0	643.6	314.0	228.4	643.0	314.0	372.7	642.4
314.0	517.1	641.8	314.0	661.4	641.2	314.0	805.8	640.5
314.0	950.1	639.9	314.0	1094.4	639.3	314.0	1238.8	638.7
314.0	1383.1	638.1	314.0	1527.5	637.5	314.0	1671.8	636.9
314.0	1816.2	636.3	314.0	1960.5	635.7	314.0	2104.9	49.1
314.0	2104.9	195.6	314.0	2104.9	342.1	314.0	2104.9	488.6
314.0	2104.9	635.1	314.0	2194.9	49.1	314.0	2284.9	49.1
314.0	2284.9	199.1	314.0	2284.9	349.1	314.0	2284.9	499.1
314.0	2284.9	649.1	314.0	2428.7	649.1	314.0	2572.6	649.1
314.0	2716.5	649.1	314.0	2860.3	649.1	314.0	3004.2	649.1
314.0	3148.0	649.1	314.0	3291.9	649.1	314.0	3435.8	649.1
314.0	3579.6	649.1	314.0	3723.5	649.1	314.0	3867.3	649.1
314.0	4011.2	649.1	314.0	4155.0	649.1	314.0	4298.9	649.1
314.0	4442.8	649.1	314.0	-1215.1	978.5	314.0	-1215.1	1128.0
314.0	-1215.1	1277.4	314.0	-1215.1	1426.9	314.0	-1215.1	1576.3
314.0	-1215.1	1725.7	314.0	-1215.1	1875.2	314.0	-1215.1	2024.6
314.0	-1215.1	2174.1	314.0	-1215.1	2323.5	314.0	-1215.1	2473.0
314.0	-1215.1	2622.4	314.0	-1215.1	2771.9	314.0	-1215.1	2921.3
314.0	-1215.1	3070.8	314.0	-1215.1	3220.2	314.0	-1215.1	3369.7
314.0	-1215.1	829.1	314.0	-1066.3	829.1	314.0	-917.4	829.1
314.0	-768.6	829.1	314.0	-619.8	829.1	314.0	-470.9	829.1
314.0	-322.1	829.1	314.0	-173.2	829.1	314.0	-24.4	829.1
314.0	124.4	829.1	314.0	273.3	829.1	314.0	422.1	829.1
314.0	571.0	829.1	314.0	719.8	829.1	314.0	868.6	829.1
314.0	1017.5	829.1	314.0	1166.3	829.1	314.0	1315.1	829.1

KINGDOM OF THAILAND
CHOKCHAI KHATKHAJORN
โชคชัย ขัตขจร
สย. 4522
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Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
314.0	1464.0	829.1	314.0	1612.8	829.1	314.0	1761.7	829.1
314.0	1910.5	829.1	314.0	2059.3	829.1	314.0	2208.2	829.1
314.0	2357.0	829.1	314.0	2505.9	829.1	314.0	2654.7	829.1
314.0	2803.5	829.1	314.0	2952.4	829.1	314.0	3101.2	829.1
314.0	3250.0	829.1	314.0	3398.9	829.1	314.0	3547.7	829.1
314.0	3696.6	829.1	314.0	3845.4	829.1	314.0	3994.2	829.1
314.0	4143.1	829.1	314.0	4291.9	829.1	314.0	4440.8	829.1
314.0	-1395.1	974.7	314.0	-1395.1	1124.2	314.0	-1395.1	1273.7
314.0	-1395.1	1423.2	314.0	-1395.1	1572.7	314.0	-1395.1	1722.2
314.0	-1395.1	1871.7	314.0	-1395.1	2021.1	314.0	-1395.1	2170.6
314.0	-1395.1	2320.1	314.0	-1395.1	2469.6	314.0	-1395.1	2619.1
314.0	-1395.1	2768.6	314.0	-1395.1	2918.1	314.0	-1395.1	3067.6
314.0	-1395.1	3217.1	314.0	-1395.1	3366.6	314.0	-1096.1	3629.1
314.0	-960.8	3629.1	314.0	-825.4	3629.1	314.0	-690.1	3629.1
314.0	-1096.1	3449.1	314.0	-960.8	3449.1	314.0	-825.4	3449.1
314.0	-690.1	3449.1	314.0	4004.9	3443.1	314.0	4004.9	3533.1
314.0	4004.9	3623.1	314.0	4126.6	3443.1	314.0	4126.6	3623.1
314.0	4248.4	3443.1	314.0	4248.4	3623.1	314.0	4370.1	3443.1
314.0	4370.1	3623.1	314.0	4491.9	3443.1	314.0	4491.9	3623.1
314.0	4529.9	2199.3	314.0	4529.9	2344.8	314.0	4529.9	2490.4
314.0	4529.9	2636.0	314.0	4529.9	2781.6	314.0	4529.9	2927.2
314.0	4529.9	3072.7	314.0	4529.9	3218.3	314.0	4529.9	3363.9
314.0	4529.9	889.1	314.0	4529.9	1034.6	314.0	4529.9	1180.2
314.0	4529.9	1325.8	314.0	4529.9	1471.4	314.0	4529.9	1617.0
314.0	4529.9	1762.5	314.0	4529.9	1908.1	314.0	4529.9	2053.7
314.0	4709.9	2780.0	314.0	4709.9	2925.5	314.0	4709.9	3070.9
314.0	4709.9	3216.4	314.0	4709.9	3361.9	314.0	4709.9	1616.4
314.0	4709.9	1761.8	314.0	4709.9	1907.3	314.0	4709.9	2052.7
314.0	4709.9	2198.2	314.0	4709.9	2343.7	314.0	4709.9	2489.1
314.0	4709.9	2634.6	314.0	4709.9	889.1	314.0	4709.9	1034.5
314.0	4709.9	1180.0	314.0	4709.9	1325.4	314.0	4709.9	1470.9
314.0	-1096.1	-2105.6	314.0	-947.0	-2105.1	314.0	-797.8	-2104.6
314.0	-648.7	-2104.1	314.0	-499.5	-2103.5	314.0	-350.3	-2103.0
314.0	-201.2	-2102.5	314.0	-52.0	-2102.0	314.0	97.1	-2101.4
314.0	246.3	-2100.9	314.0	395.4	-2100.4	314.0	544.6	-2099.8
314.0	693.7	-2099.3	314.0	842.9	-2098.8	314.0	992.0	-2098.3
314.0	1141.2	-2097.7	314.0	1290.3	-2097.2	314.0	1439.5	-2096.7
314.0	1588.6	-2096.2	314.0	1737.8	-2095.6	314.0	1887.0	-2095.1
314.0	-3712.6	-2106.4	314.0	-3567.6	-2105.4	314.0	-3422.7	-2104.4
314.0	-3277.7	-2103.4	314.0	-3132.8	-2102.4	314.0	-2987.8	-2101.4
314.0	-2842.9	-2100.4	314.0	-2697.9	-2099.4	314.0	-2553.0	-2098.4
314.0	-2408.0	-2097.3	314.0	-2263.1	-2096.3	314.0	-2118.1	-2095.3
314.0	-1973.2	-2094.3	314.0	-1828.2	-2093.3	314.0	-1683.3	-2092.3
314.0	-1538.3	-2091.3						

5. Factored Loads and Moments with Corresponding Capacity Ratios

NOTE: Calculations are based on "Critical Capacity" Method.

No.	Demand P_u kN	M_{ux} kNm	M_{uy} kNm	Capacity ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Parameters at Capacity NA Depth mm	ε_t	ϕ	Capacity Ratio
1	8100.00	14430.00	65540.00	0.00	30474.13	138411.25	1198	0.01435	0.900	0.69
2	39480.00	14450.00	56680.00	0.00	34248.41	134339.09	1239	0.01389	0.900	0.58
3	20190.00	18350.00	85420.00	0.00	29872.96	139059.86	1192	0.01442	0.900	0.74
4	31510.00	73530.00	81820.00	9941.86	85603.32	95254.51	1802	0.00866	0.900	0.83
5	27190.00	26660.00	147420.00	10277.38	30177.01	166867.83	1420	0.01159	0.900	0.87
6	32520.00	91080.00	88620.00	19341.96	99519.65	96831.69	2023	0.00739	0.900	0.89
7	28190.00	28530.00	17183.00	0.00	93711.84	56440.61	1514	0.01093	0.900	0.51

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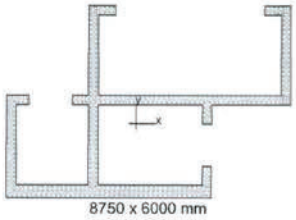
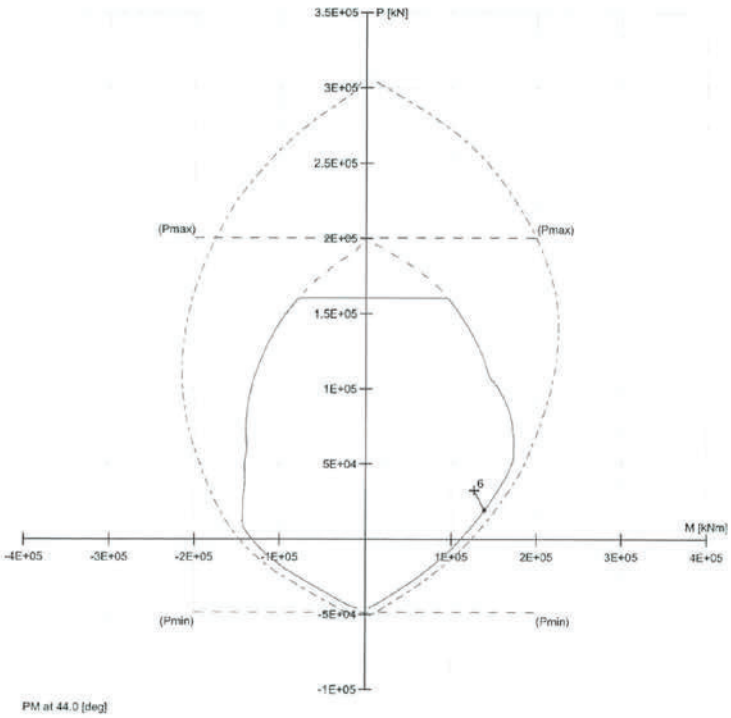
6. Diagrams

6.1. PM at θ=44 [deg]





General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials	
f'_c	35 MPa
E_c	27805.6 MPa
f_y	400 MPa
E_s	200000 MPa

Section	
Type	Irregular
A_g	8.6825e+006 mm²
I_x	2.8376e+013 mm⁴
I_y	6.17429e+013 mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	135020 mm²
Rho	1.56 %
Min. clear spacing	18 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
6	32520.0	91080.0	88620.0	19341.96	99519.65	96831.69	0.89

Max. Capacity Ratio: 0.89

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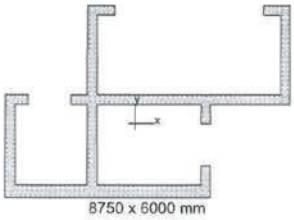
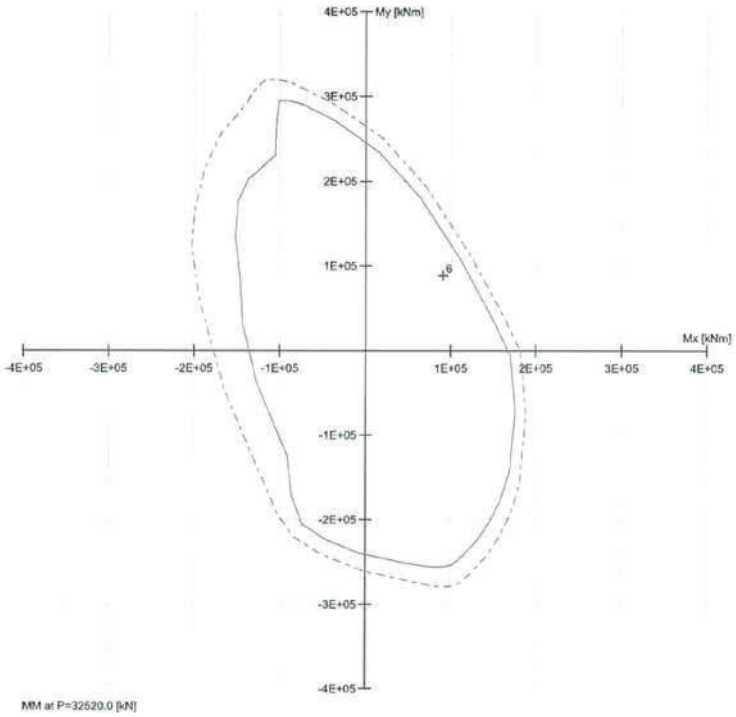
6.2. MM at P=32520 [kN]





General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials		
f'_c	35	MPa
E_c	27805.6	MPa
f_y	400	MPa
E_s	200000	MPa

Section		
Type	Irregular	
A_g	8.6825e+006	mm^2
I_x	2.8376e+013	mm^4
I_y	6.17429e+013	mm^4

Reinforcement		
Pattern	Irregular	
Bar layout	---	
Cover to	---	
Clear cover	---	
Bars	---	
Confinement type	Tied	
Total steel area, A_s	135020	mm^2
Rho	1.56	%
Min. clear spacing	18	mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
6	32520.0	91080.0	88620.0	19341.96	99519.65	96831.69	0.89

Max. Capacity Ratio: 0.89

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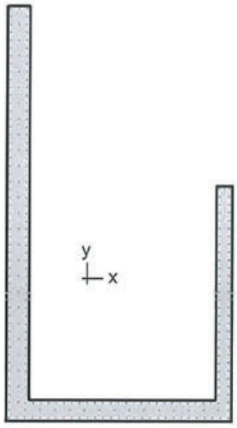
spColumn

spColumn v6.50
Computer program for the Strength Design of Reinforced Concrete Sections



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StructurePoint

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1. General Information

File Name	C:\193018\GCDT\SPcloumn\10-09-63(C1 ...\P4-L2.col
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

2. Material Properties

2.1. Concrete

Type	Standard	
f'_c	35	MPa
E_c	27805.6	MPa
f_c	29.75	MPa
ε_u	0.003	mm/mm
β_1	0.796192	

2.2. Steel

Type	Standard	
f_y	400	MPa
E_s	200000	MPa
ε_{yt}	0.002	mm/mm

3. Section

3.1. Shape and Properties

Type	Irregular	
A_g	6.07125e+006	mm^2
I_x	3.34113e+013	mm^4
I_y	1.65083e+013	mm^4
r_x	2345.89	mm
r_y	1648.97	mm
X_o	0	mm
Y_o	-0.000168664	mm

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3.2. Section Figure

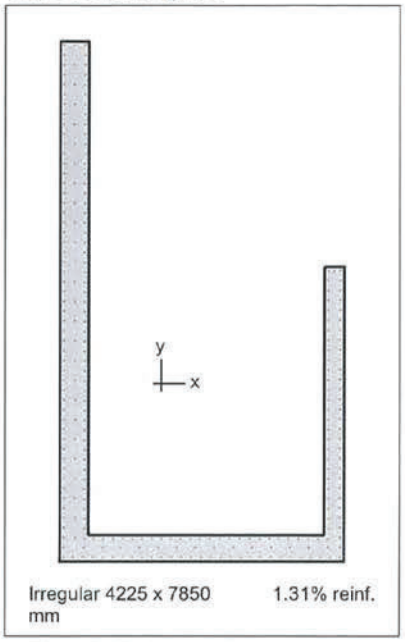

Figure 1: Column section

3.3. Exterior Points

Points	X mm	Y mm	Points	X mm	Y mm	Points	X mm	Y mm
1	2710.6	1757.8	2	2410.6	1757.8	3	2410.6	-2292.2
4	-1089.4	-2292.2	5	-1089.4	5157.8	6	-1514.4	5157.8
7	-1514.4	-2692.2	8	2710.6	-2692.2			

4. Reinforcement

4.1. Bar Set: ASTM A615

Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²
#3	9.53	70.97	#4	12.70	129.03	#5	15.88	200.00
#6	19.05	283.87	#7	22.23	387.10	#8	25.40	509.68
#9	28.65	645.16	#10	32.26	819.35	#11	35.81	1006.45
#14	43.00	1451.61	#18	57.33	2580.64			

4.2. Confinement and Factors

Confinement type	Tied
For #10 bars or less	#3 ties
For larger bars	#4 ties
Capacity Reduction Factors	
Axial compression, (a)	0.8
Tension controlled ϕ, (b)	0.9
Compression controlled ϕ, (c)	0.65

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4.3. Arrangement

Pattern	Irregular
Bar layout	---

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Cover to	---
Clear cover	---
Bars	---
Total steel area, A_s	79756 mm²
Rho	1.31 %
Minimum clear spacing	70 mm

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4.4. Bars Provided

Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
314.0	-1454.4	-2632.2	314.0	-1454.4	-2483.6	314.0	-1454.4	-2334.9
314.0	-1454.4	-2186.3	314.0	-1454.4	-2037.6	314.0	-1454.4	-1889.0
314.0	-1454.4	-1740.3	314.0	-1454.4	-1591.6	314.0	-1454.4	-1443.0
314.0	-1454.4	-1294.3	314.0	-1454.4	-1145.7	314.0	-1454.4	-997.0
314.0	-1454.4	-848.4	314.0	-1454.4	-699.7	314.0	-1454.4	-551.1
314.0	-1454.4	-402.4	314.0	-1454.4	-253.8	314.0	-1454.4	-105.1
314.0	-1454.4	43.5	314.0	-1454.4	192.2	314.0	-1454.4	340.9
314.0	-1454.4	489.5	314.0	-1454.4	638.2	314.0	-1454.4	786.8
314.0	-1454.4	935.5	314.0	-1454.4	1084.1	314.0	-1454.4	1232.8
314.0	-1454.4	1381.4	314.0	-1454.4	1530.1	314.0	-1454.4	1678.7
314.0	-1454.4	1827.4	314.0	-1454.4	1976.0	314.0	-1454.4	2124.7
314.0	-1454.4	2273.4	314.0	-1454.4	2422.0	314.0	-1454.4	2570.7
314.0	-1454.4	2719.3	314.0	-1454.4	2868.0	314.0	-1454.4	3016.6
314.0	-1454.4	3165.3	314.0	-1454.4	3313.9	314.0	-1454.4	3462.6
314.0	-1454.4	3611.2	314.0	-1454.4	3759.9	314.0	-1454.4	3908.5
314.0	-1454.4	4057.2	314.0	-1454.4	4205.9	314.0	-1454.4	4354.5
314.0	-1454.4	4503.2	314.0	-1454.4	4651.8	314.0	-1454.4	4800.5
314.0	-1454.4	4949.1	314.0	-1454.4	5097.8	314.0	-1307.8	-2632.2
314.0	-1161.2	-2632.2	314.0	-1149.4	-2352.2	314.0	-1149.4	-2203.2
314.0	-1149.4	-2054.2	314.0	-1149.4	-1905.2	314.0	-1149.4	-1756.2
314.0	-1149.4	-1607.2	314.0	-1149.4	-1458.2	314.0	-1149.4	-1309.2
314.0	-1149.4	-1160.2	314.0	-1149.4	-1011.2	314.0	-1149.4	-862.2
314.0	-1149.4	-713.2	314.0	-1149.4	-564.2	314.0	-1149.4	-415.2
314.0	-1149.4	-266.2	314.0	-1149.4	-117.2	314.0	-1149.4	31.8
314.0	-1149.4	180.8	314.0	-1149.4	329.8	314.0	-1149.4	478.8
314.0	-1149.4	627.8	314.0	-1149.4	776.8	314.0	-1149.4	925.8
314.0	-1149.4	1074.8	314.0	-1149.4	1223.8	314.0	-1149.4	1372.8
314.0	-1149.4	1521.8	314.0	-1149.4	1670.8	314.0	-1149.4	1819.8
314.0	-1149.4	1968.8	314.0	-1149.4	2117.8	314.0	-1149.4	2266.8
314.0	-1149.4	2415.8	314.0	-1149.4	2564.8	314.0	-1149.4	2713.8
314.0	-1149.4	2862.8	314.0	-1149.4	3011.8	314.0	-1149.4	3160.8
314.0	-1149.4	3309.8	314.0	-1149.4	3458.8	314.0	-1149.4	3607.8
314.0	-1149.4	3756.8	314.0	-1149.4	3905.8	314.0	-1149.4	4054.8
314.0	-1149.4	4203.8	314.0	-1149.4	4352.8	314.0	-1149.4	4501.8
314.0	-1149.4	4650.8	314.0	-1149.4	4799.8	314.0	-1149.4	4948.8
314.0	-1149.4	5097.8	314.0	-1014.5	-2632.2	314.0	-1004.6	-2352.2
314.0	-867.9	-2632.2	314.0	-859.8	-2352.2	314.0	-721.3	-2632.2
314.0	-715.0	-2352.2	314.0	-574.7	-2632.2	314.0	-570.2	-2352.2
314.0	-428.1	-2632.2	314.0	-425.4	-2352.2	314.0	-281.5	-2632.2
314.0	-280.6	-2352.2	314.0	-135.8	-2352.2	314.0	-134.9	-2632.2
314.0	9.0	-2352.2	314.0	11.7	-2632.2	314.0	153.8	-2352.2
314.0	158.3	-2632.2	314.0	298.6	-2352.2	314.0	304.9	-2632.2
314.0	443.4	-2352.2	314.0	451.5	-2632.2	314.0	588.2	-2352.2
314.0	598.1	-2632.2	314.0	733.0	-2352.2	314.0	744.7	-2632.2
314.0	877.8	-2352.2	314.0	891.4	-2632.2	314.0	1022.6	-2352.2
314.0	1038.0	-2632.2	314.0	1167.4	-2352.2	314.0	1184.6	-2632.2
314.0	1312.2	-2352.2	314.0	1331.2	-2632.2	314.0	1457.0	-2352.2
314.0	1477.8	-2632.2	314.0	1601.8	-2352.2	314.0	1624.4	-2632.2
314.0	1746.6	-2352.2	314.0	1771.0	-2632.2	314.0	1891.4	-2352.2

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Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
314.0	1917.6	-2632.2	314.0	2036.2	-2352.2	314.0	2064.2	-2632.2
314.0	2181.0	-2352.2	314.0	2210.8	-2632.2	314.0	2325.8	-2352.2
314.0	2357.4	-2632.2	314.0	2470.6	-2352.2	314.0	2470.6	-2202.2
314.0	2470.6	-2052.2	314.0	2470.6	-1902.2	314.0	2470.6	-1752.2
314.0	2470.6	-1602.2	314.0	2470.6	-1452.2	314.0	2470.6	-1302.2
314.0	2470.6	-1152.2	314.0	2470.6	-1002.2	314.0	2470.6	-852.2
314.0	2470.6	-702.2	314.0	2470.6	-552.2	314.0	2470.6	-402.2
314.0	2470.6	-252.2	314.0	2470.6	-102.2	314.0	2470.6	47.8
314.0	2470.6	197.8	314.0	2470.6	347.8	314.0	2470.6	497.8
314.0	2470.6	647.8	314.0	2470.6	797.8	314.0	2470.6	947.8
314.0	2470.6	1097.8	314.0	2470.6	1247.8	314.0	2470.6	1397.8
314.0	2470.6	1547.8	314.0	2470.6	1697.8	314.0	2504.0	-2632.2
314.0	2560.6	1697.8	314.0	2650.6	-2632.2	314.0	2650.6	-2482.9
314.0	2650.6	-2333.6	314.0	2650.6	-2184.3	314.0	2650.6	-2035.0
314.0	2650.6	-1885.7	314.0	2650.6	-1736.4	314.0	2650.6	-1587.1
314.0	2650.6	-1437.7	314.0	2650.6	-1288.4	314.0	2650.6	-1139.1
314.0	2650.6	-989.8	314.0	2650.6	-840.5	314.0	2650.6	-691.2
314.0	2650.6	-541.9	314.0	2650.6	-392.6	314.0	2650.6	-243.3
314.0	2650.6	-93.9	314.0	2650.6	55.4	314.0	2650.6	204.7
314.0	2650.6	354.0	314.0	2650.6	503.3	314.0	2650.6	652.6
314.0	2650.6	801.9	314.0	2650.6	951.2	314.0	2650.6	1100.5
314.0	2650.6	1249.8	314.0	2650.6	1399.2	314.0	2650.6	1548.5
314.0	2650.6	1697.8	314.0	-1301.9	5097.8	314.0	-1301.1	4800.5
314.0	-1300.3	4503.1	314.0	-1299.6	4205.8	314.0	-1298.8	3908.5
314.0	-1298.0	3611.2	314.0	-1297.3	3313.9	314.0	-1296.5	3016.5
314.0	-1295.7	2719.2	314.0	-1295.0	2421.9	314.0	-1294.2	2124.6
314.0	-1293.5	1827.3	314.0	-1292.7	1529.9	314.0	-1291.9	1232.6
314.0	-1291.2	935.3	314.0	-1290.4	638.0	314.0	-1289.6	340.7
314.0	-1288.9	43.3	314.0	-1288.1	-254.0	314.0	-1287.3	-551.3
314.0	-1286.6	-848.6	314.0	-1285.8	-1145.9	314.0	-1285.0	-1443.3
314.0	-1284.3	-1740.6	314.0	-1283.5	-2037.9	314.0	-1282.7	-2335.2
314.0	-1152.3	-2485.8	314.0	-873.9	-2485.6	314.0	-595.5	-2485.5
314.0	-317.1	-2485.3	314.0	-38.8	-2485.1	314.0	239.6	-2485.0
314.0	518.0	-2484.8	314.0	796.4	-2484.7	314.0	1074.7	-2484.5
314.0	1353.1	-2484.4	314.0	1631.5	-2484.2	314.0	1909.9	-2484.1
314.0	2188.3	-2483.9	314.0	2466.6	-2483.8			

5. Factored Loads and Moments with Corresponding Capacity Ratios

NOTE: Calculations are based on "Critical Capacity" Method.

No.	Demand			Capacity			Parameters at Capacity			Capacity Ratio
	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	NA Depth mm	ε_t	ϕ	
1	8950.00	22220.00	7760.00	0.00	72261.95	25236.40	372	0.07828	0.900	0.74
2	42930.00	17590.00	13670.00	0.00	67910.73	52776.55	996	0.02369	0.900	0.51
3	29860.00	48030.00	18960.00	4712.17	83456.88	32944.88	482	0.05947	0.900	0.71
4	23560.00	17000.00	18640.00	0.00	58490.25	64132.84	1174	0.01686	0.900	0.62
5	32950.00	38240.00	41760.00	3097.69	64167.63	70074.27	1281	0.01539	0.900	0.67
6	37620.00	99840.00	77.00	20602.70	120536.41	92.96	850	0.02596	0.900	0.81

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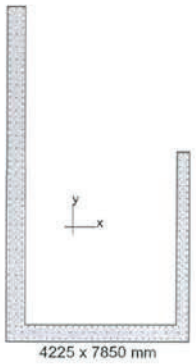
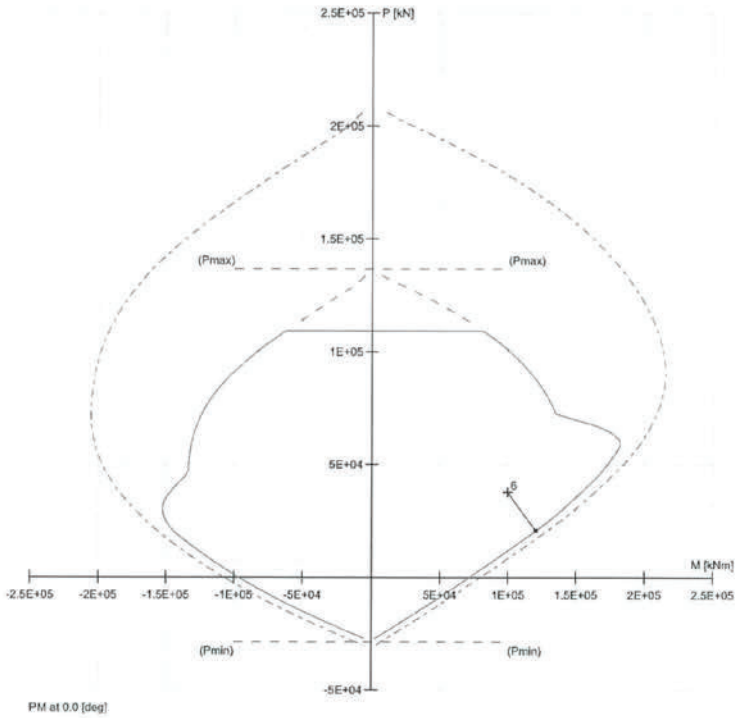
6. Diagrams

6.1. PM at θ=0 [deg]





General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials	
f'_c	35 MPa
E_c	27805.6 MPa
f_y	400 MPa
E_s	200000 MPa

Section	
Type	Irregular
A_g	6.07125e+006 mm²
I_x	3.34113e+013 mm⁴
I_y	1.65083e+013 mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	79756 mm²
Rho	1.31 %
Min. clear spacing	70 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
6	37620.0	99840.0	77.0	20602.70	120536.41	92.96	0.81

Max. Capacity Ratio: 0.81

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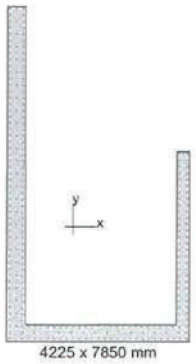
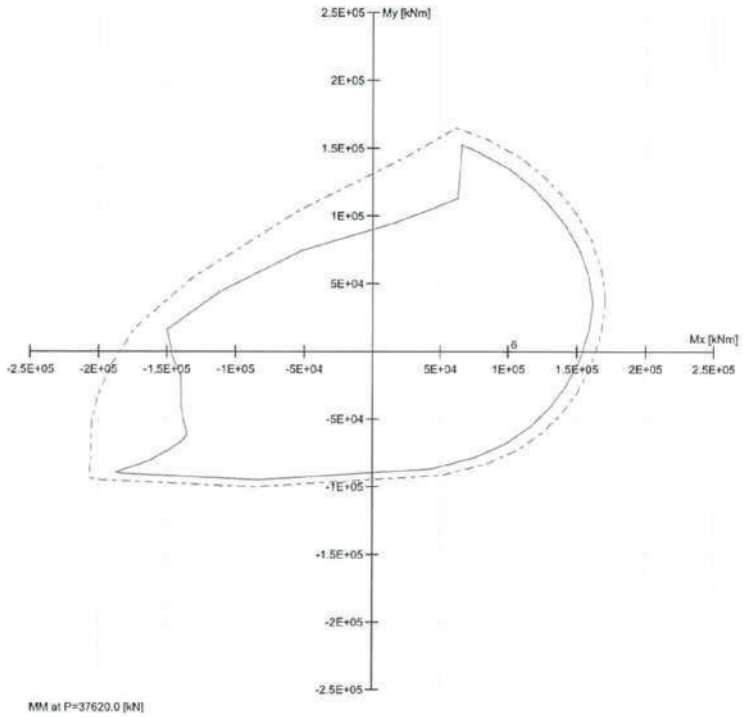
6.2. MM at P=37620 [kN]





General Information	
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Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials	
f'_c	35 MPa
E_c	27805.6 MPa
f_y	400 MPa
E_s	200000 MPa

Section	
Type	Irregular
A_g	6.07125e+006 mm²
I_x	3.34113e+013 mm⁴
I_y	1.65083e+013 mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	79756 mm²
Rho	1.31 %
Min. clear spacing	70 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
6	37620.0	99840.0	77.0	20602.70	120536.41	92.96	0.81

Max. Capacity Ratio: 0.81

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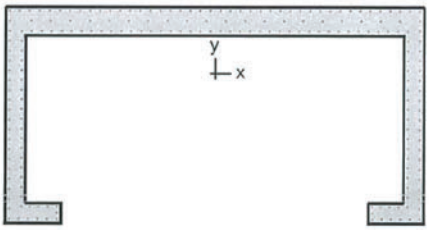
spColumn v6.50
Computer program for the Strength Design of Reinforced Concrete Sections



KINGDOM OF THAILAND
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StructurePoint

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STRUCTUREPOINT - spColumn v6.50
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C:\193018\GCDT\SPcloumn\10-09-63(C1 building)\SP(shear wall)\P5-L2.col

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1. General Information

File Name	C:\193018\GCDT\SPcloumn\10-09-63(C1 ...\P5-L2.col
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

2. Material Properties

2.1. Concrete

Type	Standard	
f'_c	35	MPa
E_c	27805.6	MPa
f_c	29.75	MPa
ε_u	0.003	mm/mm
β_1	0.796192	

2.2. Steel

Type	Standard	
f_y	400	MPa
E_s	200000	MPa
ε_{yt}	0.002	mm/mm

3. Section

3.1. Shape and Properties

Type	Irregular	
A_g	4.63e+006	mm^2
I_x	5.27319e+012	mm^4
I_y	2.51091e+013	mm^4
r_x	1067.2	mm
r_y	2328.76	mm
X_o	0	mm
Y_o	0	mm

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3.2. Section Figure

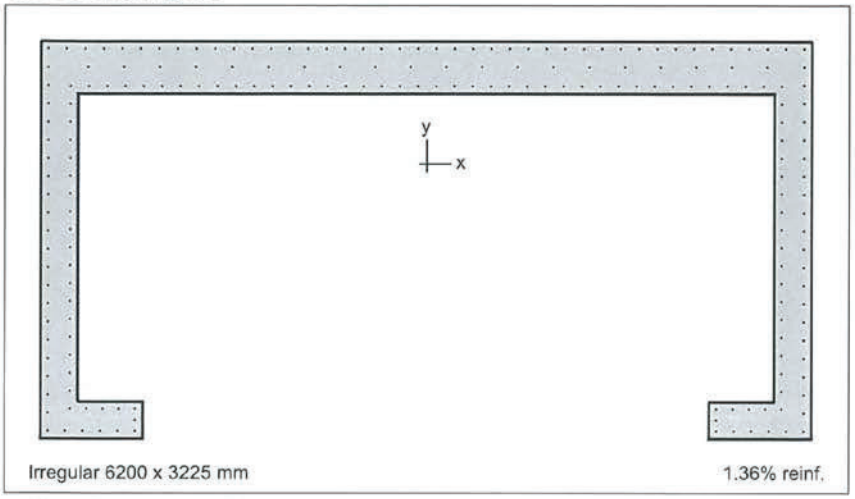

Figure 1: Column section

3.3. Exterior Points

Points	X	Y	Points	X	Y	Points	X	Y
	mm	mm		mm	mm		mm	mm
1	-2275.0	-1932.7	2	-2800.0	-1932.7	3	-2800.0	567.3
4	2800.0	567.3	5	2800.0	-1932.7	6	2275.0	-1932.7
7	2275.0	-2232.7	8	3100.0	-2232.7	9	3100.0	992.3
10	-3100.0	992.3	11	-3100.0	-2232.7	12	-2275.0	-2232.7

4. Reinforcement

4.1. Bar Set: ASTM A615

Bar	Diameter	Area	Bar	Diameter	Area	Bar	Diameter	Area
	mm	mm²		mm	mm²		mm	mm²
#3	9.53	70.97	#4	12.70	129.03	#5	15.88	200.00
#6	19.05	283.87	#7	22.23	387.10	#8	25.40	509.68
#9	28.65	645.16	#10	32.26	819.35	#11	35.81	1006.45
#14	43.00	1451.61	#18	57.33	2580.64			

4.2. Confinement and Factors

Confinement type	Tied
For #10 bars or less	#3 ties
For larger bars	#4 ties
Capacity Reduction Factors	
Axial compression, (a)	0.8
Tension controlled ϕ, (b)	0.9
Compression controlled ϕ, (c)	0.65

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4.3. Arrangement

Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---

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Total steel area, A_s	62800	mm²
Rho	1.36	%
Minimum clear spacing	70	mm

4.4. Bars Provided

Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
314.0	-3040.0	932.3	314.0	-2899.6	-2172.7	314.0	-2891.7	932.3
314.0	-2860.0	-1992.7	314.0	-2860.0	-1847.1	314.0	-2860.0	-1701.5
314.0	-2860.0	-1556.0	314.0	-2860.0	-1410.4	314.0	-2860.0	-1264.9
314.0	-2860.0	-1119.3	314.0	-2860.0	-973.8	314.0	-2860.0	-828.2
314.0	-2860.0	-682.7	314.0	-2860.0	-537.1	314.0	-2860.0	-391.5
314.0	-2860.0	-246.0	314.0	-2860.0	-100.4	314.0	-2860.0	45.1
314.0	-2860.0	190.7	314.0	-2860.0	336.2	314.0	-2860.0	481.8
314.0	-2860.0	627.3	314.0	-2759.2	-2172.7	314.0	-2743.4	932.3
314.0	-2729.5	-1992.7	314.0	-2713.3	627.3	314.0	-2618.8	-2172.7
314.0	-2599.0	-1992.7	314.0	-2595.1	932.3	314.0	-2566.7	627.3
314.0	-2478.4	-2172.7	314.0	-2468.5	-1992.7	314.0	-2446.8	932.3
314.0	-2420.0	627.3	314.0	-2338.0	-2172.7	314.0	-2338.0	-2082.7
314.0	-2338.0	-1992.7	314.0	-2298.5	932.3	314.0	-2273.3	627.3
314.0	-2150.2	932.3	314.0	-2126.7	627.3	314.0	-2002.0	932.3
314.0	-1980.0	627.3	314.0	-1853.7	932.3	314.0	-1833.3	627.3
314.0	-1705.4	932.3	314.0	-1686.7	627.3	314.0	-1557.1	932.3
314.0	-1540.0	627.3	314.0	-1408.8	932.3	314.0	-1393.3	627.3
314.0	-1260.5	932.3	314.0	-1246.7	627.3	314.0	-1112.2	932.3
314.0	-1100.0	627.3	314.0	-963.9	932.3	314.0	-953.3	627.3
314.0	-815.6	932.3	314.0	-806.7	627.3	314.0	-667.3	932.3
314.0	-660.0	627.3	314.0	-519.0	932.3	314.0	-513.3	627.3
314.0	-370.7	932.3	314.0	-366.7	627.3	314.0	-222.4	932.3
314.0	-220.0	627.3	314.0	-74.1	932.3	314.0	-73.3	627.3
314.0	73.3	627.3	314.0	74.1	932.3	314.0	220.0	627.3
314.0	222.4	932.3	314.0	366.7	627.3	314.0	370.7	932.3
314.0	513.3	627.3	314.0	519.0	932.3	314.0	660.0	627.3
314.0	667.3	932.3	314.0	806.7	627.3	314.0	815.6	932.3
314.0	953.3	627.3	314.0	963.9	932.3	314.0	1100.0	627.3
314.0	1112.2	932.3	314.0	1246.7	627.3	314.0	1260.5	932.3
314.0	1393.3	627.3	314.0	1408.8	932.3	314.0	1540.0	627.3
314.0	1557.1	932.3	314.0	1686.7	627.3	314.0	1705.4	932.3
314.0	1833.3	627.3	314.0	1853.7	932.3	314.0	1980.0	627.3
314.0	2002.0	932.3	314.0	2126.7	627.3	314.0	2150.2	932.3
314.0	2273.3	627.3	314.0	2298.5	932.3	314.0	2335.0	-2172.7
314.0	2335.0	-2082.7	314.0	2335.0	-1992.7	314.0	2420.0	627.3
314.0	2446.8	932.3	314.0	2466.2	-1992.7	314.0	2476.0	-2172.7
314.0	2566.7	627.3	314.0	2595.1	932.3	314.0	2597.5	-1992.7
314.0	2617.0	-2172.7	314.0	2713.3	627.3	314.0	2728.7	-1992.7
314.0	2743.4	932.3	314.0	2758.0	-2172.7	314.0	2860.0	-1992.7
314.0	2860.0	-1847.1	314.0	2860.0	-1701.5	314.0	2860.0	-1556.0
314.0	2860.0	-1410.4	314.0	2860.0	-1264.9	314.0	2860.0	-1119.3
314.0	2860.0	-973.8	314.0	2860.0	-828.2	314.0	2860.0	-682.7
314.0	2860.0	-537.1	314.0	2860.0	-391.5	314.0	2860.0	-246.0
314.0	2860.0	-100.4	314.0	2860.0	45.1	314.0	2860.0	190.7
314.0	2860.0	336.2	314.0	2860.0	481.8	314.0	2860.0	627.3
314.0	2891.7	932.3	314.0	2899.0	-2172.7	314.0	3040.0	-2172.7
314.0	3040.0	-2024.8	314.0	3040.0	-1876.9	314.0	3040.0	-1729.1
314.0	3040.0	-1581.2	314.0	3040.0	-1433.4	314.0	3040.0	-1285.5
314.0	3040.0	-1137.7	314.0	3040.0	-989.8	314.0	3040.0	-841.9
314.0	3040.0	-694.1	314.0	3040.0	-546.2	314.0	3040.0	-398.4
314.0	3040.0	-250.5	314.0	3040.0	-102.7	314.0	3040.0	45.2
314.0	3040.0	193.1	314.0	3040.0	340.9	314.0	3040.0	488.8
314.0	3040.0	636.6	314.0	3040.0	784.5	314.0	3040.0	932.3

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Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
314.0	-3040.0	-548.7	314.0	-3040.0	-401.1	314.0	-3040.0	-253.5
314.0	-3040.0	-105.9	314.0	-3040.0	41.8	314.0	-3040.0	189.4
314.0	-3040.0	337.0	314.0	-3040.0	484.7	314.0	-3040.0	632.3
314.0	-3040.0	779.9	314.0	-3040.0	-2172.7	314.0	-3040.0	-2025.0
314.0	-3040.0	-1877.4	314.0	-3040.0	-1729.8	314.0	-3040.0	-1582.1
314.0	-3040.0	-1434.5	314.0	-3040.0	-1286.9	314.0	-3040.0	-1139.3
314.0	-3040.0	-991.6	314.0	-3040.0	-844.0	314.0	-3040.0	-696.4
314.0	-2719.0	784.3	314.0	-2431.6	784.2	314.0	-2144.2	784.1
314.0	-1856.7	784.0	314.0	-1569.3	783.9	314.0	-1281.9	783.9
314.0	-994.5	783.8	314.0	-707.1	783.7	314.0	-419.6	783.6
314.0	-132.2	783.5	314.0	155.2	783.4	314.0	442.6	783.3
314.0	730.1	783.2	314.0	1017.5	783.1	314.0	1304.9	783.0
314.0	1592.3	782.9	314.0	1879.7	782.8	314.0	2167.2	782.7
314.0	2454.6	782.6	314.0	2742.0	782.5			

5. Factored Loads and Moments with Corresponding Capacity Ratios

NOTE: Calculations are based on "Critical Capacity" Method.

No.	Demand			Capacity			Parameters at Capacity			Capacity Ratio
	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	NA Depth mm	ε_t	ϕ	
1	5660.00	4260.00	7710.00	0.00	34613.90	62646.29	1609	0.00743	0.900	0.39
2	27940.00	2700.00	21030.00	0.00	8667.66	67511.40	307	0.06737	0.900	0.55
3	16230.00	4470.00	45140.00	0.00	6666.78	67324.03	354	0.06088	0.900	0.76
4	19660.00	8810.00	23510.00	0.00	24968.12	66628.86	544	0.03511	0.900	0.54
5	21650.00	7050.00	82060.00	10885.20	8396.39	97731.63	675	0.02829	0.900	0.84
6	24820.00	18280.00	25300.00	23492.01	38103.29	52735.95	3178	0.00185	0.650	0.64
7	22200.00	7470.00	98340.00	15327.44	8291.05	109148.80	898	0.01944	0.900	0.89

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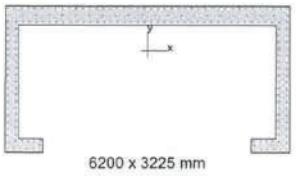
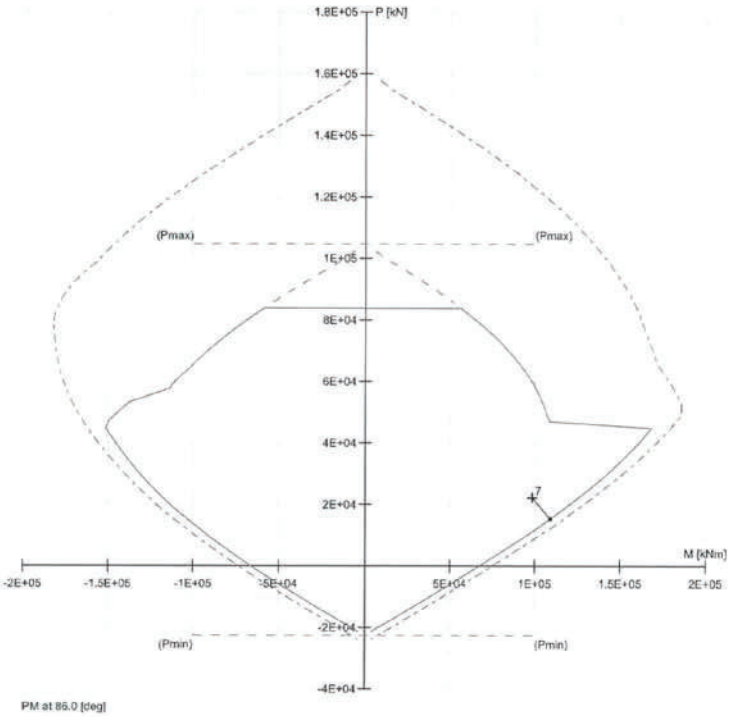
6. Diagrams

6.1. PM at θ=86 [deg]





General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials	
f'_c	35 MPa
E_c	27805.6 MPa
f_y	400 MPa
E_s	200000 MPa

Section	
Type	Irregular
A_g	4.63e+006 mm²
I_x	5.27319e+012 mm⁴
I_y	2.51091e+013 mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	62800 mm²
Rho	1.36 %
Min. clear spacing	70 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
7	22200.0	7470.0	98340.0	15327.44	8291.05	109148.80	0.89

Max. Capacity Ratio: 0.89

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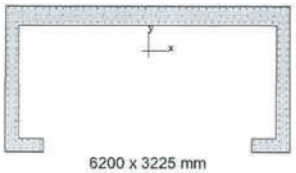
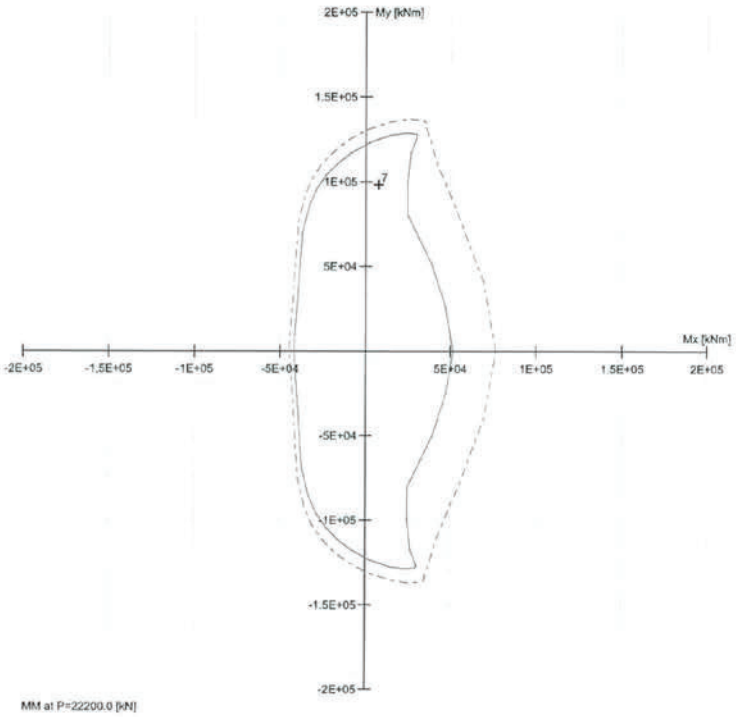
6.2. MM at P=22200 [kN]





General Information	
Project	---
Column	---
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7	22200.0	7470.0	98340.0	15327.44	8291.05	109148.80	0.89

Max. Capacity Ratio: 0.89

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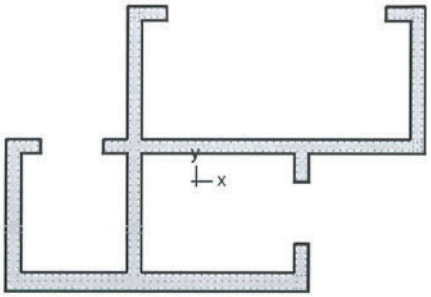

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1. General Information

File Name	C:\193018\GCDT\SPcloumn\10-09-63(C1 ...\P6-L2.col
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

2. Material Properties

2.1. Concrete

Type	Standard	
f'_c	35	MPa
E_c	27805.6	MPa
f_c	29.75	MPa
ε_u	0.003	mm/mm
β_1	0.796192	

2.2. Steel

Type	Standard	
f_y	400	MPa
E_s	200000	MPa
ε_{yt}	0.002	mm/mm

3. Section

3.1. Shape and Properties

Type	Irregular	
A_g	8.6825e+006	mm^2
I_x	2.8376e+013	mm^4
I_y	6.17429e+013	mm^4
r_x	1807.81	mm
r_y	2666.68	mm
X_o	-0.000117938	mm
Y_o	-0.000235877	mm

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3.2. Section Figure

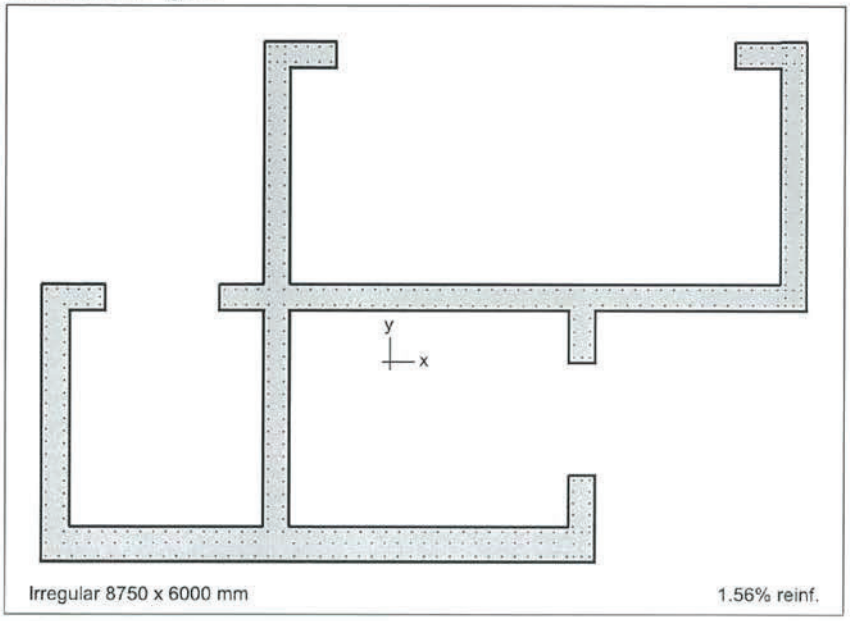

Figure 1: Column section

3.3. Exterior Points

Points	X mm	Y mm	Points	X mm	Y mm	Points	X mm	Y mm
1	2344.9	-1310.9	2	2044.9	-1310.9	3	2044.9	-1910.9
4	-1155.1	-1910.9	5	-1155.1	589.1	6	2044.9	589.1
7	2044.9	-10.9	8	2344.9	-10.9	9	2344.9	589.1
10	4769.9	589.1	11	4769.9	3689.1	12	4469.9	3689.1
13	4469.9	3683.1	14	3944.9	3683.1	15	3944.9	3383.1
16	4469.9	3383.1	17	4469.9	889.1	18	-1155.1	889.1
19	-1155.1	3389.1	20	-630.1	3389.1	21	-630.1	3689.1
22	-1455.1	3689.1	23	-1455.1	889.1	24	-1955.1	889.1
25	-1955.1	589.1	26	-1455.1	589.1	27	-1455.1	-1910.9
28	-3655.1	-1910.9	29	-3655.1	589.1	30	-3255.1	589.1
31	-3255.1	889.1	32	-3980.1	889.1	33	-3980.1	-2310.9
34	2344.9	-2310.9						

4. Reinforcement

4.1. Bar Set: ASTM A615

Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²	Bar	Diameter mm	Area mm²
#3	9.53	70.97	#4	12.70	129.03	#5	15.88	200.00
#6	19.05	283.87	#7	22.23	387.10	#8	25.40	509.68
#9	28.65	645.16	#10	32.26	819.35	#11	35.81	1006.45
#14	43.00	1451.61	#18	57.33	2580.64			

4.2. Confinement and Factors

Confinement type	Tied
For #10 bars or less	#3 ties
For larger bars	#4 ties
Capacity Reduction Factors	
Axial compression, (a)	0.8

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Tension controlled ϕ, (b)	0.9
Compression controlled ϕ, (c)	0.65

4.3. Arrangement

Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Total steel area, A_s	135020 mm²
Rho	1.56 %
Minimum clear spacing	18 mm

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4.4. Bars Provided

Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
314.0	-1395.1	3629.1	314.0	-1305.1	3629.1	314.0	-1215.1	3629.1
314.0	-1215.1	3539.1	314.0	-1215.1	3449.1	314.0	-1305.1	3449.1
314.0	-1395.1	3449.1	314.0	-1395.1	3539.1	314.0	4709.9	3629.1
314.0	4619.9	3629.1	314.0	4529.9	3629.1	314.0	4529.9	3536.1
314.0	4529.9	3443.1	314.0	4619.9	3443.1	314.0	4709.9	3443.1
314.0	4709.9	3536.1	314.0	4709.9	649.1	314.0	4619.9	649.1
314.0	4529.9	649.1	314.0	4529.9	739.1	314.0	4529.9	829.1
314.0	4619.9	829.1	314.0	4709.9	829.1	314.0	4709.9	739.1
314.0	2104.9	-1970.9	314.0	2194.9	-1970.9	314.0	2284.9	-1970.9
314.0	2284.9	-2110.9	314.0	2284.9	-2250.9	314.0	2194.9	-2250.9
314.0	2104.9	-2250.9	314.0	2104.9	-2110.9	314.0	2104.9	-1370.9
314.0	2194.9	-1370.9	314.0	2284.9	-1504.4	314.0	2284.9	-1370.9
314.0	2284.9	-1904.9	314.0	2284.9	-1771.4	314.0	2284.9	-1637.9
314.0	2094.9	-1504.4	314.0	2094.9	-1904.9	314.0	2094.9	-1771.4
314.0	2094.9	-1637.9	314.0	-3920.1	-2250.9	314.0	-3920.1	-2104.3
314.0	-3920.1	-1957.6	314.0	-3920.1	-1810.9	314.0	-3920.1	-1664.3
314.0	-3920.1	-1517.6	314.0	-3920.1	-1370.9	314.0	-3920.1	-1224.3
314.0	-3920.1	-1077.6	314.0	-3920.1	-930.9	314.0	-3920.1	-784.3
314.0	-3920.1	-637.6	314.0	-3920.1	-490.9	314.0	-3920.1	-344.3
314.0	-3920.1	-197.6	314.0	-3920.1	-50.9	314.0	-3920.1	95.7
314.0	-3920.1	242.4	314.0	-3920.1	389.1	314.0	-3920.1	535.7
314.0	-3920.1	682.4	314.0	-3920.1	829.1	314.0	-3799.1	829.1
314.0	-3771.3	-2250.9	314.0	-3715.1	-1970.9	314.0	-3715.1	-1825.4
314.0	-3715.1	-1679.8	314.0	-3715.1	-1534.3	314.0	-3715.1	-1388.7
314.0	-3715.1	-1243.2	314.0	-3715.1	-1097.6	314.0	-3715.1	-952.0
314.0	-3715.1	-806.5	314.0	-3715.1	-660.9	314.0	-3715.1	-515.4
314.0	-3715.1	-369.8	314.0	-3715.1	-224.3	314.0	-3715.1	-78.7
314.0	-3715.1	66.8	314.0	-3715.1	212.4	314.0	-3715.1	358.0
314.0	-3715.1	503.5	314.0	-3715.1	649.1	314.0	-3678.1	829.1
314.0	-3622.5	-2250.9	314.0	-3581.8	649.1	314.0	-3570.1	-1970.9
314.0	-3557.1	829.1	314.0	-3473.7	-2250.9	314.0	-3448.4	649.1
314.0	-3436.1	829.1	314.0	-3425.1	-1970.9	314.0	-3324.8	-2250.9
314.0	-3315.1	649.1	314.0	-3315.1	739.1	314.0	-3315.1	829.1
314.0	-3280.1	-1970.9	314.0	-3176.0	-2250.9	314.0	-3135.1	-1970.9
314.0	-3027.2	-2250.9	314.0	-2990.1	-1970.9	314.0	-2878.4	-2250.9
314.0	-2845.1	-1970.9	314.0	-2729.5	-2250.9	314.0	-2700.1	-1970.9
314.0	-2580.7	-2250.9	314.0	-2555.1	-1970.9	314.0	-2431.9	-2250.9
314.0	-2410.1	-1970.9	314.0	-2283.1	-2250.9	314.0	-2265.1	-1970.9
314.0	-2134.2	-2250.9	314.0	-2120.1	-1970.9	314.0	-1985.4	-2250.9
314.0	-1975.1	-1970.9	314.0	-1836.6	-2250.9	314.0	-1830.1	-1970.9
314.0	-1687.8	-2250.9	314.0	-1685.1	-1970.9	314.0	-1540.1	-1970.9

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Area	X	Y	Area	X	Y	Area	X	Y
mm²	mm	mm	mm²	mm	mm	mm²	mm	mm
314.0	-1539.0	-2250.9	314.0	-1395.1	-1970.9	314.0	-1395.1	-1826.2
314.0	-1395.1	-1681.4	314.0	-1395.1	-1536.6	314.0	-1395.1	-1391.8
314.0	-1395.1	-1247.0	314.0	-1395.1	-1102.3	314.0	-1395.1	-957.5
314.0	-1395.1	-812.7	314.0	-1395.1	-667.9	314.0	-1395.1	-523.2
314.0	-1395.1	-378.4	314.0	-1395.1	-233.6	314.0	-1395.1	-88.8
314.0	-1395.1	56.0	314.0	-1395.1	200.7	314.0	-1395.1	345.5
314.0	-1395.1	490.3	314.0	-1390.1	-2250.9	314.0	-1241.3	-2250.9
314.0	-1215.1	490.3	314.0	-1215.1	345.5	314.0	-1215.1	200.7
314.0	-1215.1	56.0	314.0	-1215.1	-88.8	314.0	-1215.1	-233.6
314.0	-1215.1	-378.4	314.0	-1215.1	-523.2	314.0	-1215.1	-667.9
314.0	-1215.1	-812.7	314.0	-1215.1	-957.5	314.0	-1215.1	-1102.3
314.0	-1215.1	-1247.0	314.0	-1215.1	-1391.8	314.0	-1215.1	-1536.6
314.0	-1215.1	-1970.9	314.0	-1215.1	-1681.4	314.0	-1215.1	-1826.2
314.0	-1092.5	-2250.9	314.0	-1067.5	-1970.9	314.0	-943.7	-2250.9
314.0	-919.9	-1970.9	314.0	-794.8	-2250.9	314.0	-772.3	-1970.9
314.0	-646.0	-2250.9	314.0	-624.7	-1970.9	314.0	-497.2	-2250.9
314.0	-477.1	-1970.9	314.0	-348.4	-2250.9	314.0	-329.5	-1970.9
314.0	-199.6	-2250.9	314.0	-181.9	-1970.9	314.0	-50.7	-2250.9
314.0	-34.3	-1970.9	314.0	98.1	-2250.9	314.0	113.3	-1970.9
314.0	246.9	-2250.9	314.0	260.9	-1970.9	314.0	395.7	-2250.9
314.0	408.5	-1970.9	314.0	544.6	-2250.9	314.0	556.1	-1970.9
314.0	693.4	-2250.9	314.0	703.7	-1970.9	314.0	842.2	-2250.9
314.0	851.3	-1970.9	314.0	991.0	-2250.9	314.0	998.9	-1970.9
314.0	1139.8	-2250.9	314.0	1146.5	-1970.9	314.0	1288.7	-2250.9
314.0	1294.1	-1970.9	314.0	1437.5	-2250.9	314.0	1441.7	-1970.9
314.0	1586.3	-2250.9	314.0	1589.4	-1970.9	314.0	1735.1	-2250.9
314.0	1737.0	-1970.9	314.0	1884.0	-2250.9	314.0	1884.6	-1970.9
314.0	2032.2	-1970.9	314.0	2032.8	-2250.9	314.0	-1895.1	829.1
314.0	-1770.1	829.1	314.0	-1645.1	829.1	314.0	-1520.1	829.1
314.0	-1395.1	829.1	314.0	-1895.1	649.1	314.0	-1770.1	649.1
314.0	-1645.1	649.1	314.0	-1520.1	649.1	314.0	-1395.1	649.1
314.0	-1215.1	649.1	314.0	-1070.8	648.5	314.0	-926.4	647.8
314.0	-782.1	647.2	314.0	-637.7	646.6	314.0	-493.4	646.0
314.0	-349.0	645.4	314.0	-204.7	644.8	314.0	-60.3	644.2
314.0	84.0	643.6	314.0	228.4	643.0	314.0	372.7	642.4
314.0	517.1	641.8	314.0	661.4	641.2	314.0	805.8	640.5
314.0	950.1	639.9	314.0	1094.4	639.3	314.0	1238.8	638.7
314.0	1383.1	638.1	314.0	1527.5	637.5	314.0	1671.8	636.9
314.0	1816.2	636.3	314.0	1960.5	635.7	314.0	2104.9	49.1
314.0	2104.9	195.6	314.0	2104.9	342.1	314.0	2104.9	488.6
314.0	2104.9	635.1	314.0	2194.9	49.1	314.0	2284.9	49.1
314.0	2284.9	199.1	314.0	2284.9	349.1	314.0	2284.9	499.1
314.0	2284.9	649.1	314.0	2428.7	649.1	314.0	2572.6	649.1
314.0	2716.5	649.1	314.0	2860.3	649.1	314.0	3004.2	649.1
314.0	3148.0	649.1	314.0	3291.9	649.1	314.0	3435.8	649.1
314.0	3579.6	649.1	314.0	3723.5	649.1	314.0	3867.3	649.1
314.0	4011.2	649.1	314.0	4155.0	649.1	314.0	4298.9	649.1
314.0	4442.8	649.1	314.0	-1215.1	978.5	314.0	-1215.1	1128.0
314.0	-1215.1	1277.4	314.0	-1215.1	1426.9	314.0	-1215.1	1576.3
314.0	-1215.1	1725.7	314.0	-1215.1	1875.2	314.0	-1215.1	2024.6
314.0	-1215.1	2174.1	314.0	-1215.1	2323.5	314.0	-1215.1	2473.0
314.0	-1215.1	2622.4	314.0	-1215.1	2771.9	314.0	-1215.1	2921.3
314.0	-1215.1	3070.8	314.0	-1215.1	3220.2	314.0	-1215.1	3369.7
314.0	-1215.1	829.1	314.0	-1066.3	829.1	314.0	-917.4	829.1
314.0	-768.6	829.1	314.0	-619.8	829.1	314.0	-470.9	829.1
314.0	-322.1	829.1	314.0	-173.2	829.1	314.0	-24.4	829.1
314.0	124.4	829.1	314.0	273.3	829.1	314.0	422.1	829.1
314.0	571.0	829.1	314.0	719.8	829.1	314.0	868.6	829.1
314.0	1017.5	829.1	314.0	1166.3	829.1	314.0	1315.1	829.1

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Area mm²	X mm	Y mm	Area mm²	X mm	Y mm	Area mm²	X mm	Y mm
314.0	1464.0	829.1	314.0	1612.8	829.1	314.0	1761.7	829.1
314.0	1910.5	829.1	314.0	2059.3	829.1	314.0	2208.2	829.1
314.0	2357.0	829.1	314.0	2505.9	829.1	314.0	2654.7	829.1
314.0	2803.5	829.1	314.0	2952.4	829.1	314.0	3101.2	829.1
314.0	3250.0	829.1	314.0	3398.9	829.1	314.0	3547.7	829.1
314.0	3696.6	829.1	314.0	3845.4	829.1	314.0	3994.2	829.1
314.0	4143.1	829.1	314.0	4291.9	829.1	314.0	4440.8	829.1
314.0	-1395.1	974.7	314.0	-1395.1	1124.2	314.0	-1395.1	1273.7
314.0	-1395.1	1423.2	314.0	-1395.1	1572.7	314.0	-1395.1	1722.2
314.0	-1395.1	1871.7	314.0	-1395.1	2021.1	314.0	-1395.1	2170.6
314.0	-1395.1	2320.1	314.0	-1395.1	2469.6	314.0	-1395.1	2619.1
314.0	-1395.1	2768.6	314.0	-1395.1	2918.1	314.0	-1395.1	3067.6
314.0	-1395.1	3217.1	314.0	-1395.1	3366.6	314.0	-1096.1	3629.1
314.0	-960.8	3629.1	314.0	-825.4	3629.1	314.0	-690.1	3629.1
314.0	-1096.1	3449.1	314.0	-960.8	3449.1	314.0	-825.4	3449.1
314.0	-690.1	3449.1	314.0	4004.9	3443.1	314.0	4004.9	3533.1
314.0	4004.9	3623.1	314.0	4126.6	3443.1	314.0	4126.6	3623.1
314.0	4248.4	3443.1	314.0	4248.4	3623.1	314.0	4370.1	3443.1
314.0	4370.1	3623.1	314.0	4491.9	3443.1	314.0	4491.9	3623.1
314.0	4529.9	2199.3	314.0	4529.9	2344.8	314.0	4529.9	2490.4
314.0	4529.9	2636.0	314.0	4529.9	2781.6	314.0	4529.9	2927.2
314.0	4529.9	3072.7	314.0	4529.9	3218.3	314.0	4529.9	3363.9
314.0	4529.9	889.1	314.0	4529.9	1034.6	314.0	4529.9	1180.2
314.0	4529.9	1325.8	314.0	4529.9	1471.4	314.0	4529.9	1617.0
314.0	4529.9	1762.5	314.0	4529.9	1908.1	314.0	4529.9	2053.7
314.0	4709.9	2780.0	314.0	4709.9	2925.5	314.0	4709.9	3070.9
314.0	4709.9	3216.4	314.0	4709.9	3361.9	314.0	4709.9	1616.4
314.0	4709.9	1761.8	314.0	4709.9	1907.3	314.0	4709.9	2052.7
314.0	4709.9	2198.2	314.0	4709.9	2343.7	314.0	4709.9	2489.1
314.0	4709.9	2634.6	314.0	4709.9	889.1	314.0	4709.9	1034.5
314.0	4709.9	1180.0	314.0	4709.9	1325.4	314.0	4709.9	1470.9
314.0	-1096.1	-2105.6	314.0	-947.0	-2105.1	314.0	-797.8	-2104.6
314.0	-648.7	-2104.1	314.0	-499.5	-2103.5	314.0	-350.3	-2103.0
314.0	-201.2	-2102.5	314.0	-52.0	-2102.0	314.0	97.1	-2101.4
314.0	246.3	-2100.9	314.0	395.4	-2100.4	314.0	544.6	-2099.8
314.0	693.7	-2099.3	314.0	842.9	-2098.8	314.0	992.0	-2098.3
314.0	1141.2	-2097.7	314.0	1290.3	-2097.2	314.0	1439.5	-2096.7
314.0	1588.6	-2096.2	314.0	1737.8	-2095.6	314.0	1887.0	-2095.1
314.0	-3712.6	-2106.4	314.0	-3567.6	-2105.4	314.0	-3422.7	-2104.4
314.0	-3277.7	-2103.4	314.0	-3132.8	-2102.4	314.0	-2987.8	-2101.4
314.0	-2842.9	-2100.4	314.0	-2697.9	-2099.4	314.0	-2553.0	-2098.4
314.0	-2408.0	-2097.3	314.0	-2263.1	-2096.3	314.0	-2118.1	-2095.3
314.0	-1973.2	-2094.3	314.0	-1828.2	-2093.3	314.0	-1683.3	-2092.3
314.0	-1538.3	-2091.3						

5. Factored Loads and Moments with Corresponding Capacity Ratios

NOTE: Calculations are based on "Critical Capacity" Method.

No.	Demand			Capacity			Parameters at Capacity			Capacity Ratio
	P_u	M_{ux}	M_{uy}	ϕP_n	ϕM_{nx}	ϕM_{ny}	NA Depth	ε_t	ϕ	
	kN	kNm	kNm	kN	kNm	kNm	mm			
1	9140.00	11680.00	38260.00	0.00	39335.46	128850.56	1293	0.01327	0.900	0.59
2	43180.00	2110.00	46790.00	0.00	7065.40	156677.83	1223	0.01453	0.900	0.54
3	28560.00	11559.00	81990.00	0.00	20818.40	147668.56	1141	0.01508	0.900	0.69
4	34480.00	61580.00	3120.00	0.00	106524.84	5397.17	650	0.03630	0.900	0.67
5	30180.00	18560.00	64720.00	0.00	37514.41	130815.34	1274	0.01349	0.900	0.65
6	35490.00	79010.00	3880.00	0.00	106535.33	5231.71	649	0.03642	0.900	0.73
7	38760.00	16890.00	164790.00	15864.75	19662.69	191842.20	1469	0.01096	0.900	0.83

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โชคชัย ขัดขจร
สย. 4522
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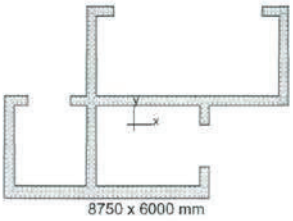
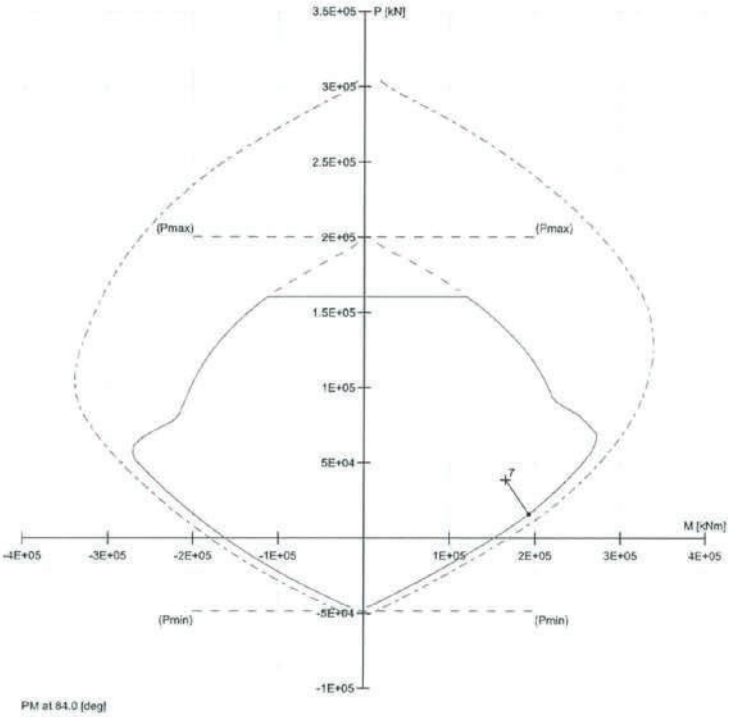
6. Diagrams

6.1. PM at θ=84 [deg]





General Information	
Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials	
f'_c	35 MPa
E_c	27805.6 MPa
f_y	400 MPa
E_s	200000 MPa

Section	
Type	Irregular
A_g	8.6825e+006 mm²
I_x	2.8376e+013 mm⁴
I_y	6.17429e+013 mm⁴

Reinforcement	
Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	135020 mm²
Rho	1.56 %
Min. clear spacing	18 mm

No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_n kN	ϕM_{nx} kNm	ϕM_{ny} kNm	Capacity Ratio
7	38760.0	16890.0	164790.0	15864.75	19662.69	191842.20	0.83

Max. Capacity Ratio: 0.83

KINGDOM OF THAILAND
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