Seismic Risk Mitigation in Palestine

Funded by

European Commission

SEVENTH FRAMEWORK PROGRAMME

Project full title:

" Support Action for Strengthening Palestinian-administrated Areas capabilities for Seismic Risk Mitigation "

An-Najah National University
Urban Planning and Disaster Risk Reduction Center

Supported by:

EUCENTRE
European Centre for Training and Research in Earthquake Engineering

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31/07/2013

RETROFITINGT

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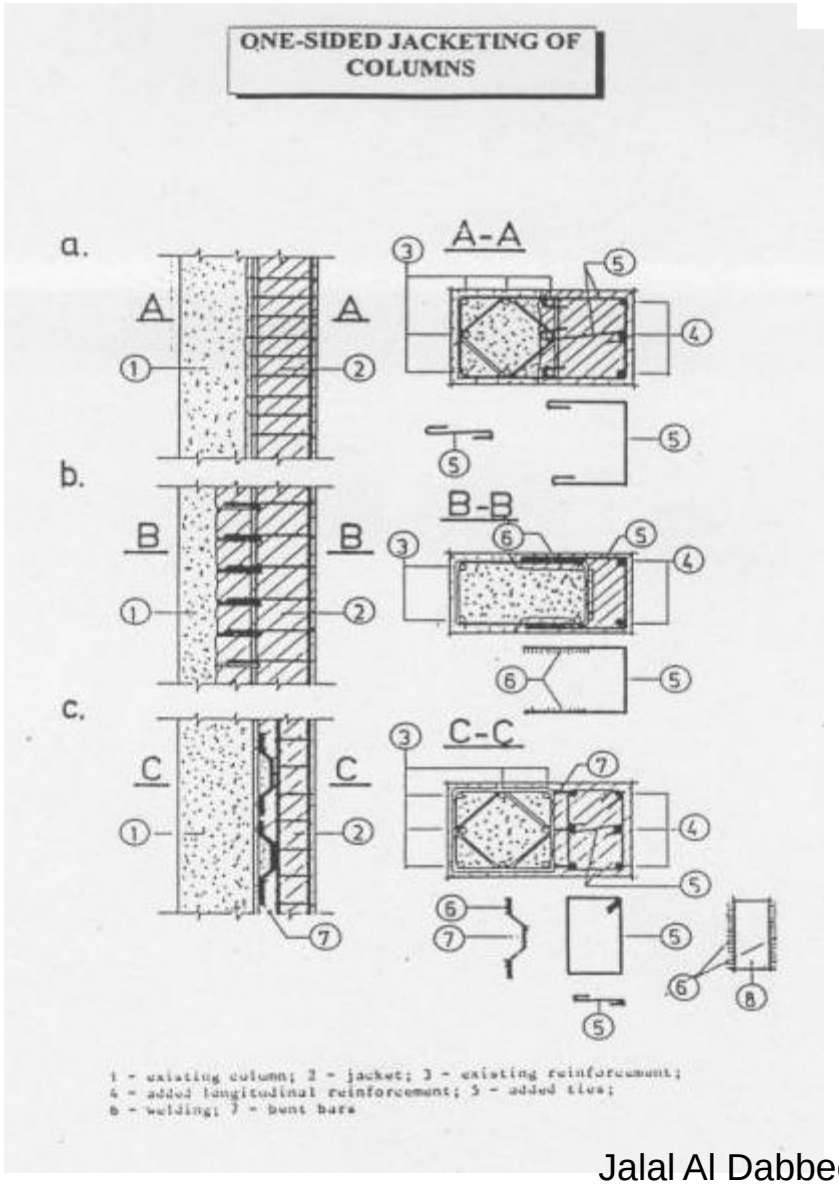
ONE-SIDED JACKETING OF COLUMNS
a.
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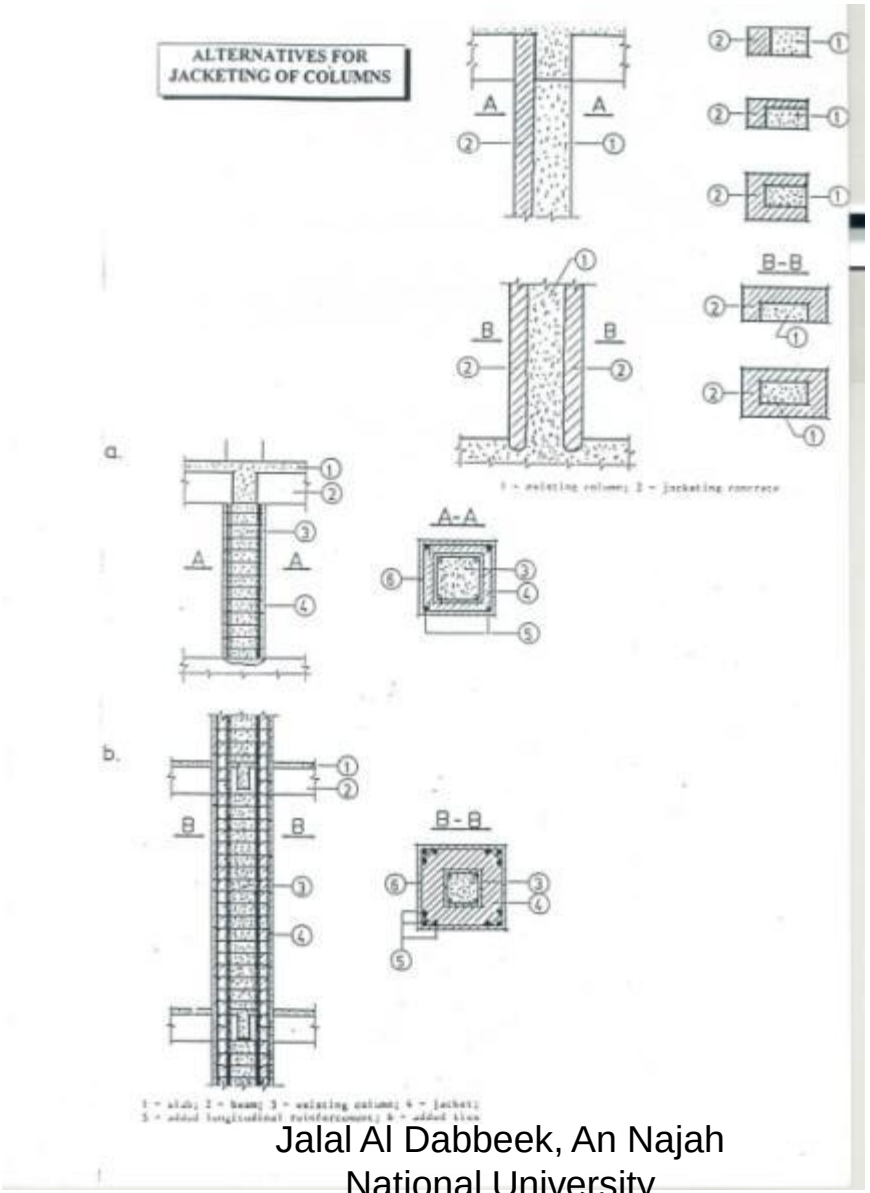
B-B
C-C
1 - existing column; 2 - jacket; 3 - existing reinforcement;
4 - added longitudinal reinforcement; 5 - added ties;
6 - welding; 7 - bent bars


ALTERNATIVES FOR
JACKETING OF COLUMNS
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B-B
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b.
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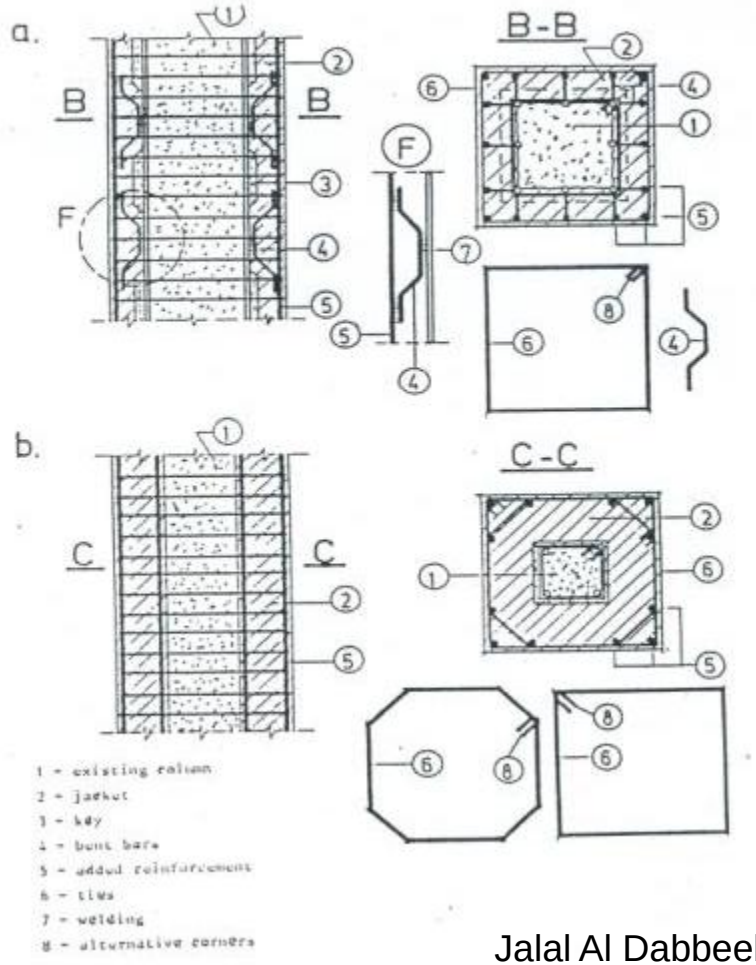
B-B

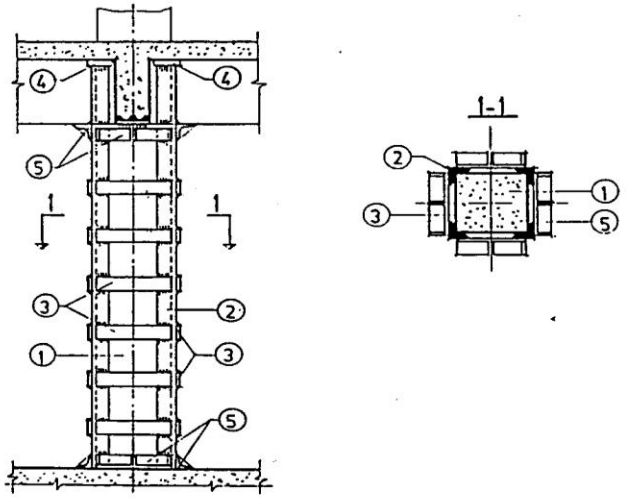
FOUR-SIDED JACKETING OF COLUMNS



STEEL PROFILE JACKETING

1. Steel profile jacketing consists of four longitudinal angle profiles placed one at each corner of the existing reinforced concrete column and connected together in a skeleton with transverse steel straps.
2. Laterals are welded to the angle profiles and can be either rebars of minimum 13 mm diameter or steel straps of minimum size 25/4 mm.
3. Angle profiles should be no less than L 50x50x5.
4. Gaps and voids between the angle profiles and the surface of the existing column must be filled with non-shrinking cement grout or resin grout.
5. A covering with concrete or shotcrete reinforced with welded fabrics is efficient for corrosion or fire protection.
6. Tight bearing between the angle profiles and the floor structures, essential for load transmitting, is achieved by an angle profile collar formed around the column perimeter in contact with the surfaces of the floor structures.

1. An improvement of the ductile behavior and an increase of the axial load capacity of the strengthened column is achieved.
2. The stiffness, however, remains relatively unchanged.



1 - existing column ; 2 - steel angle profile; 3 - steel plate;
4 - supporting beam ; 5 - tie angle profile

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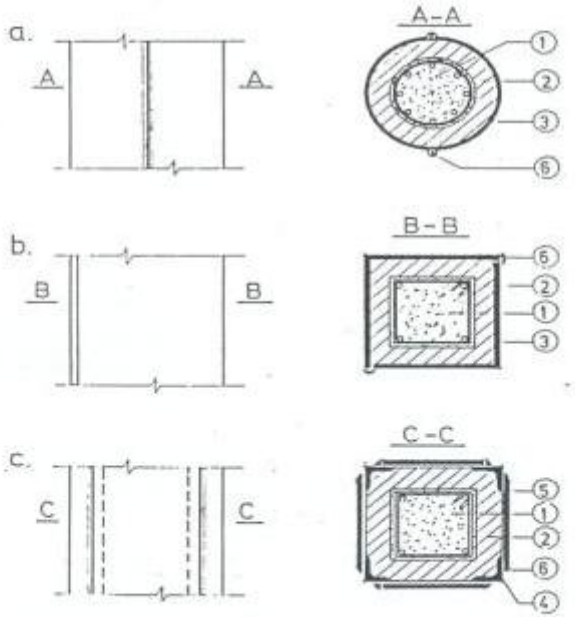
STEEL ENCASEMENT

Steel encasement is the complete covering of the existing column with thin steel plates. Steel encasement offers the possibility of only a small increase in column size.

Steel plates are continuously welded together and located at a distance from the existing column.

The voids between the encasement and the column should be filled with non-shrinking or expanding cement grout or concrete.

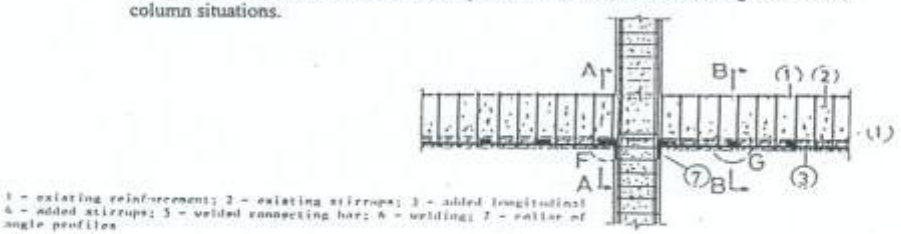
Ductility and axial strength capacity can be considerably increased locally.
However, the flexural strength of the frame structure cannot be improved by this method.
Special measures must be provided for fire and corrosion protection.

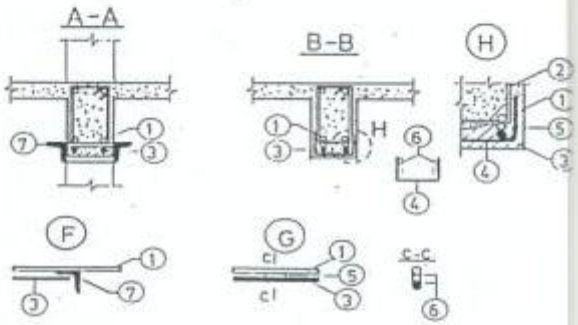


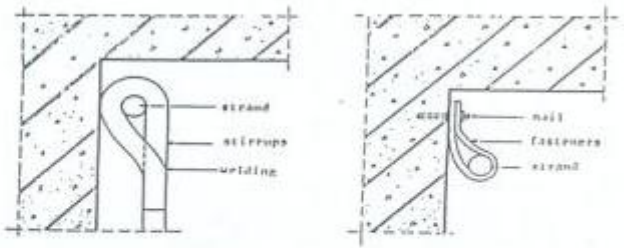
1 - existing column; 2 - new concrete or grout; 3 - steel encasement;

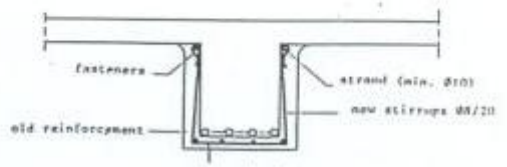
BEAMS

The purpose of strengthening deficient beams is to provide adequate strength and stiffness to resist gravity and seismic loads.
It is imperative that the rehabilitation procedure does not create strong-beam-weak-column situations.

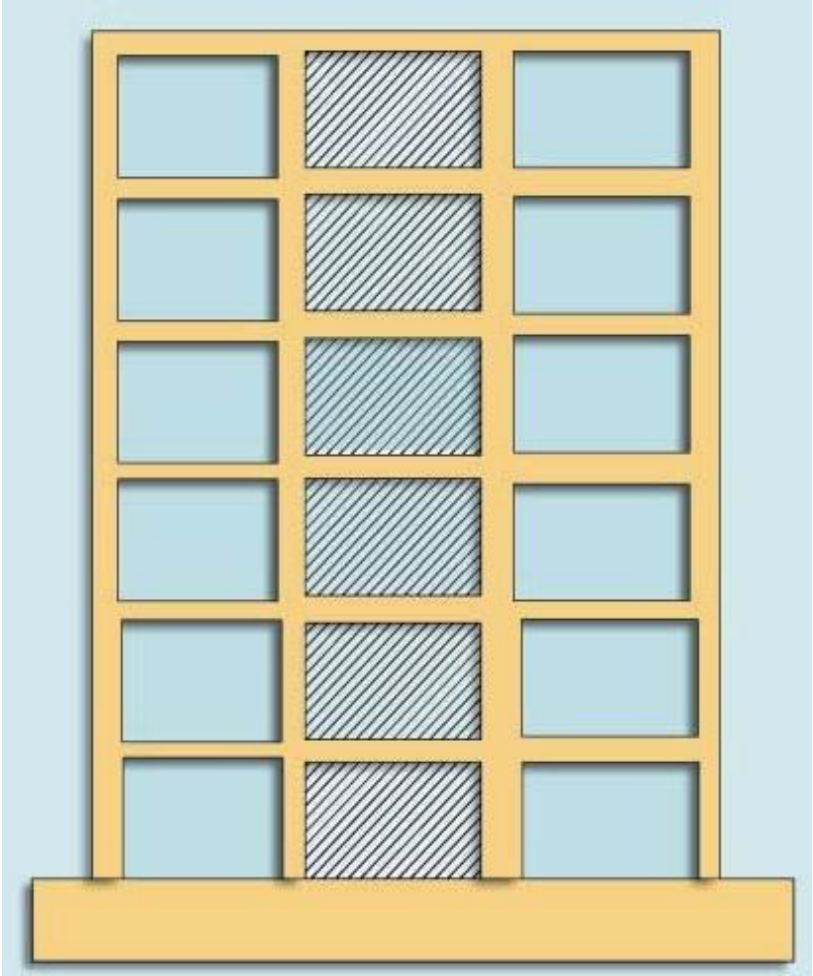








Shear Walls



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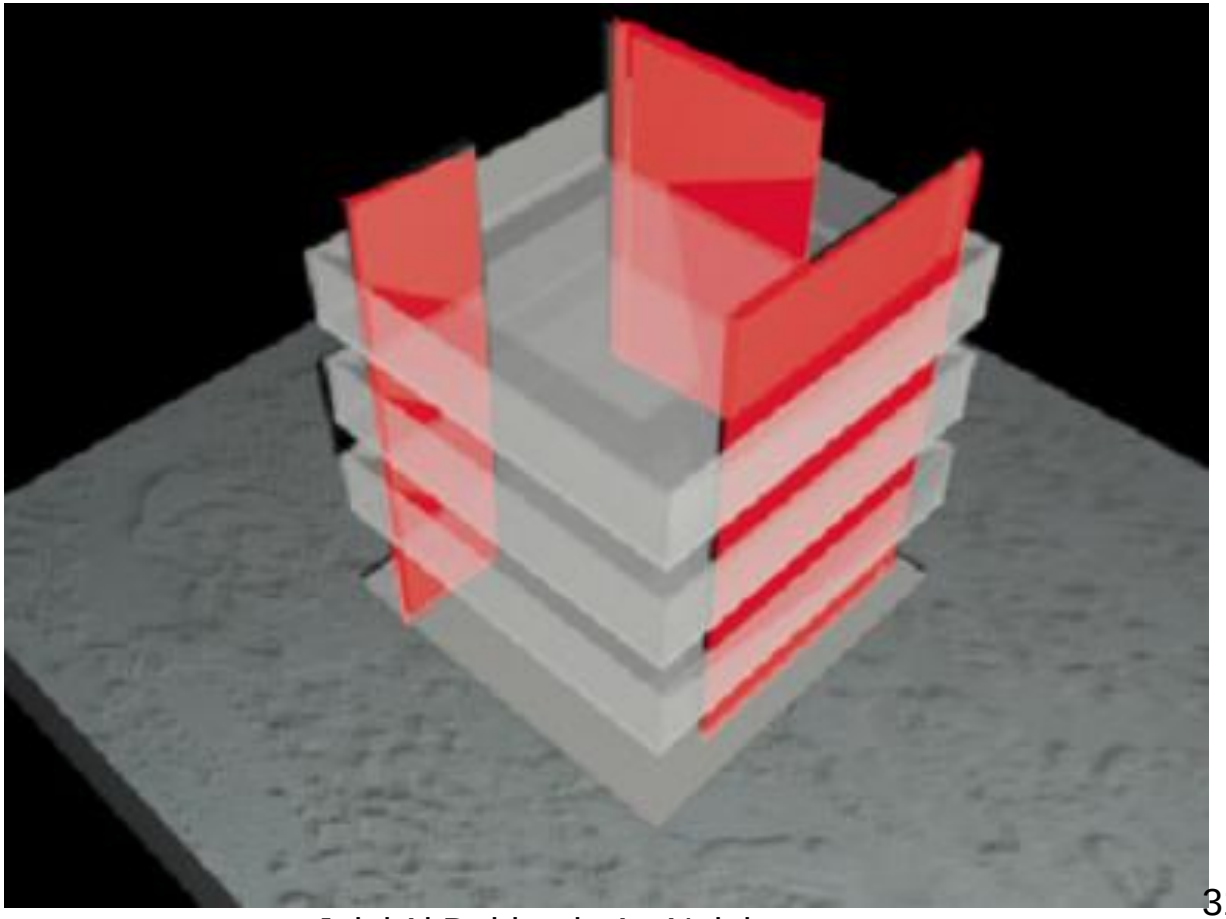


Shear Walls

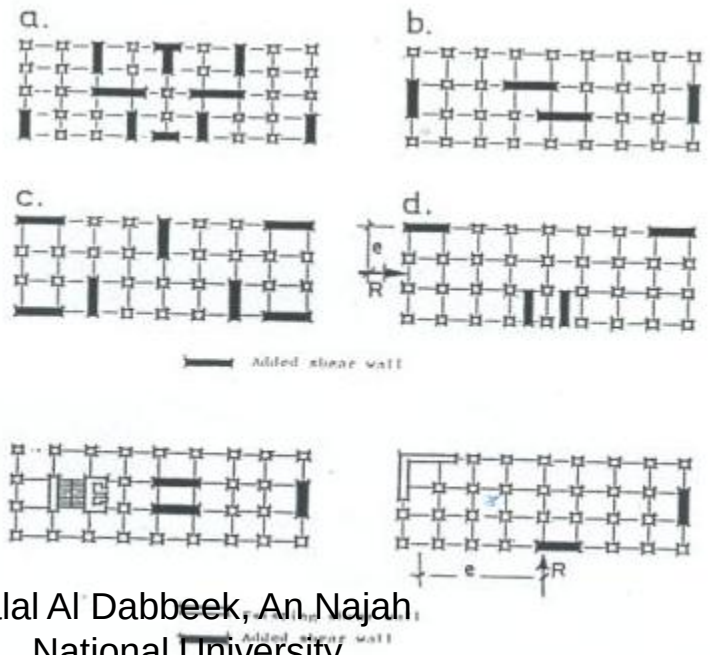
INTRODUCTION OF NEW STRUCTURAL ELEMENTS

Alternative newly added elements are:

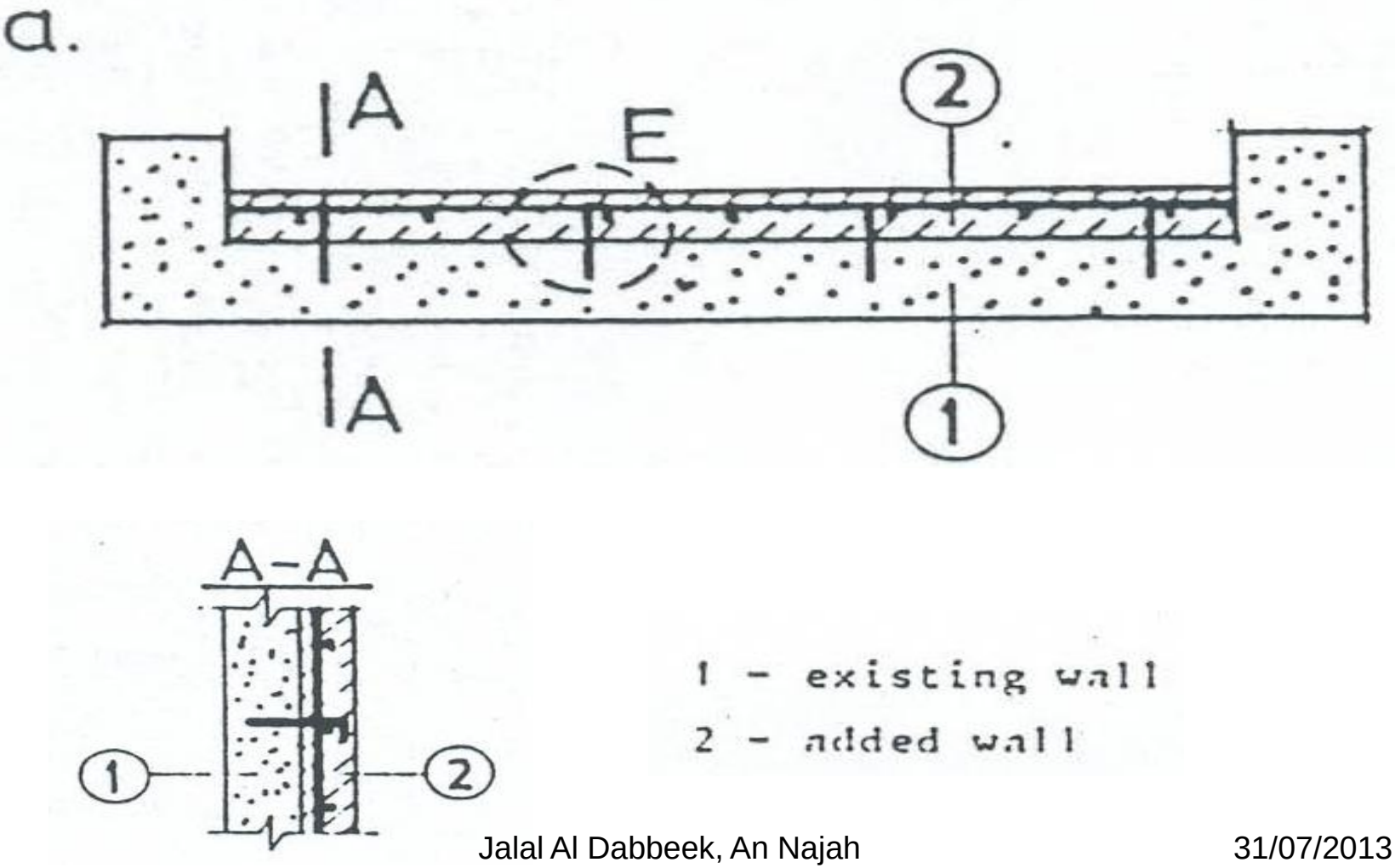
1. Shear walls in a frame or skeleton structure
2. Additional shear walls in a shear wall structure
3. Additional frames in a frame or skeleton structure
4. Bracing (steel or reinforced concrete) in a frame or skeleton structure.

It is important to observe the following:

1. Avoid large concentration of forces in members with small strength and/or ductility capacities by locating the strengthening elements uniformly throughout the structure.
2. Improve the distribution of lateral force by reducing the effects of torsion and irregularities.
3. Provide sufficient strength, stiffness and ductility of the individual elements and of the whole structure.
4. Provide adequate strength in connections between the existing structure and the newly added elements.



Shear Walls



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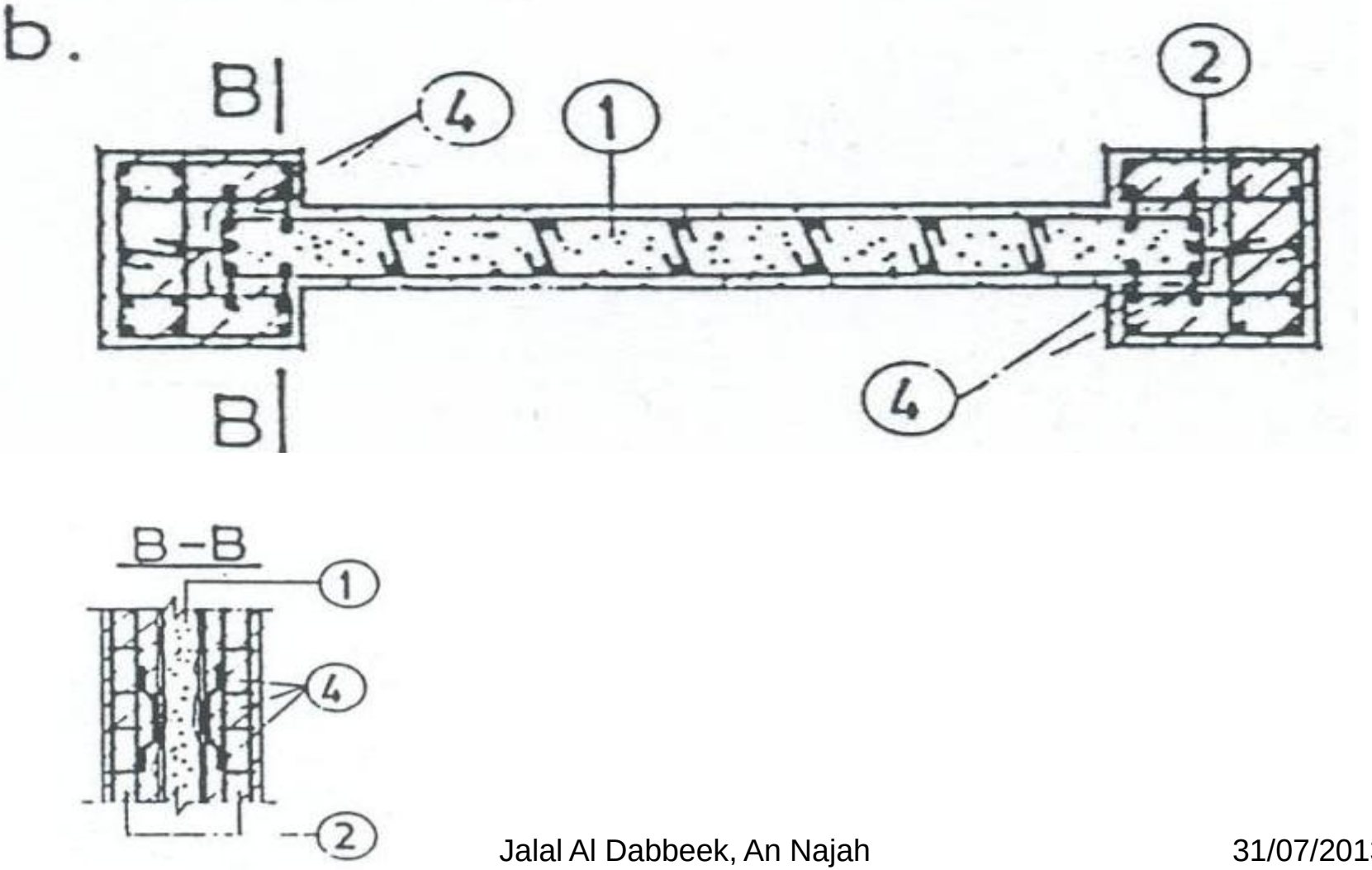

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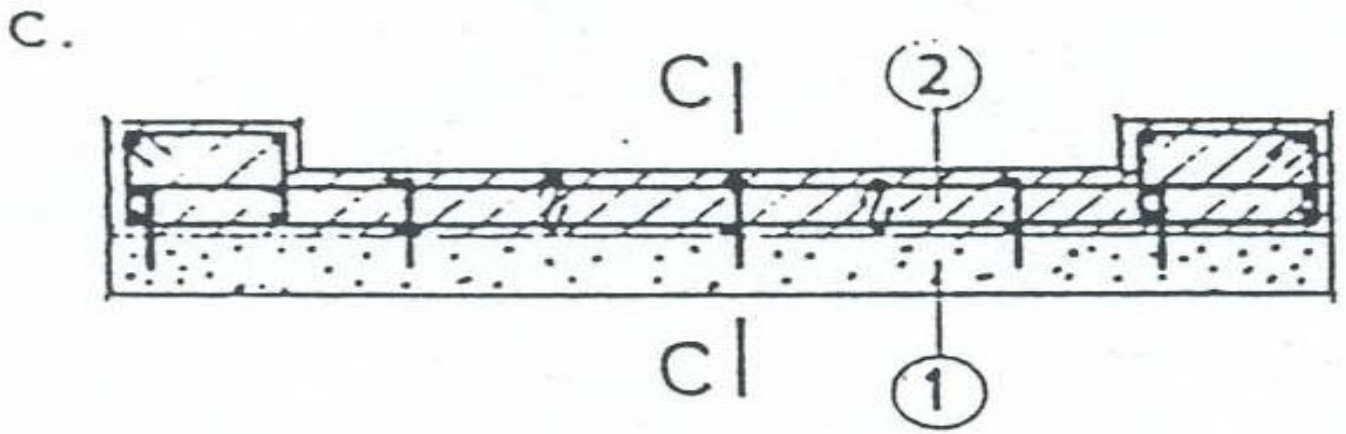

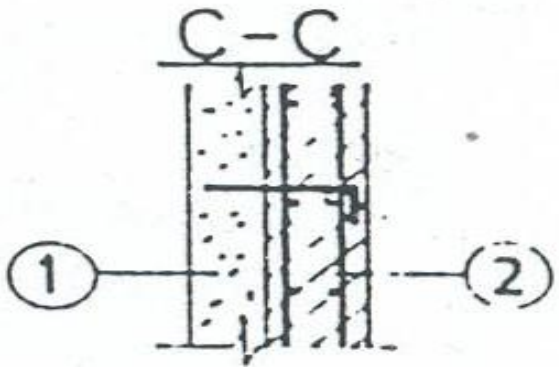

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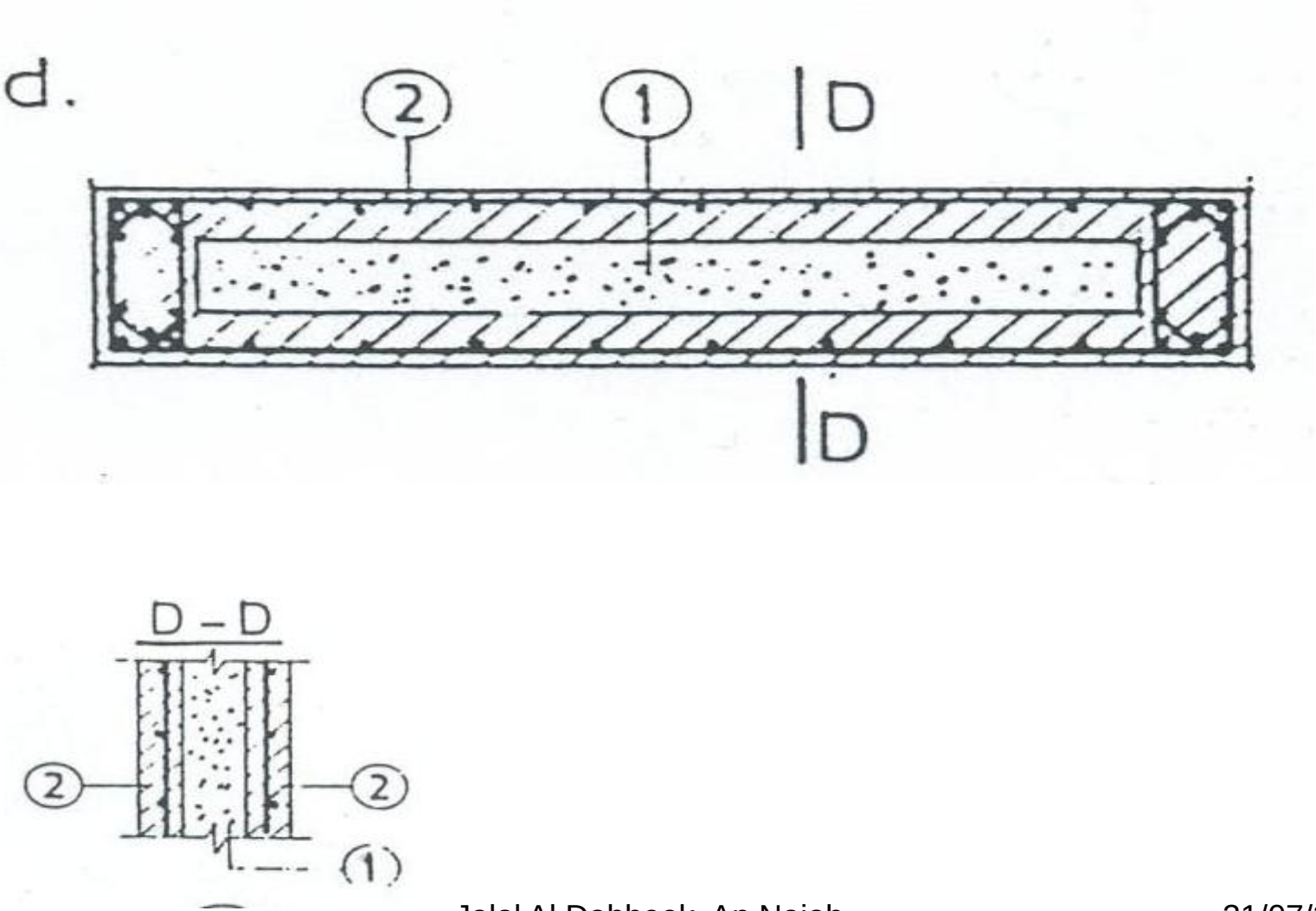

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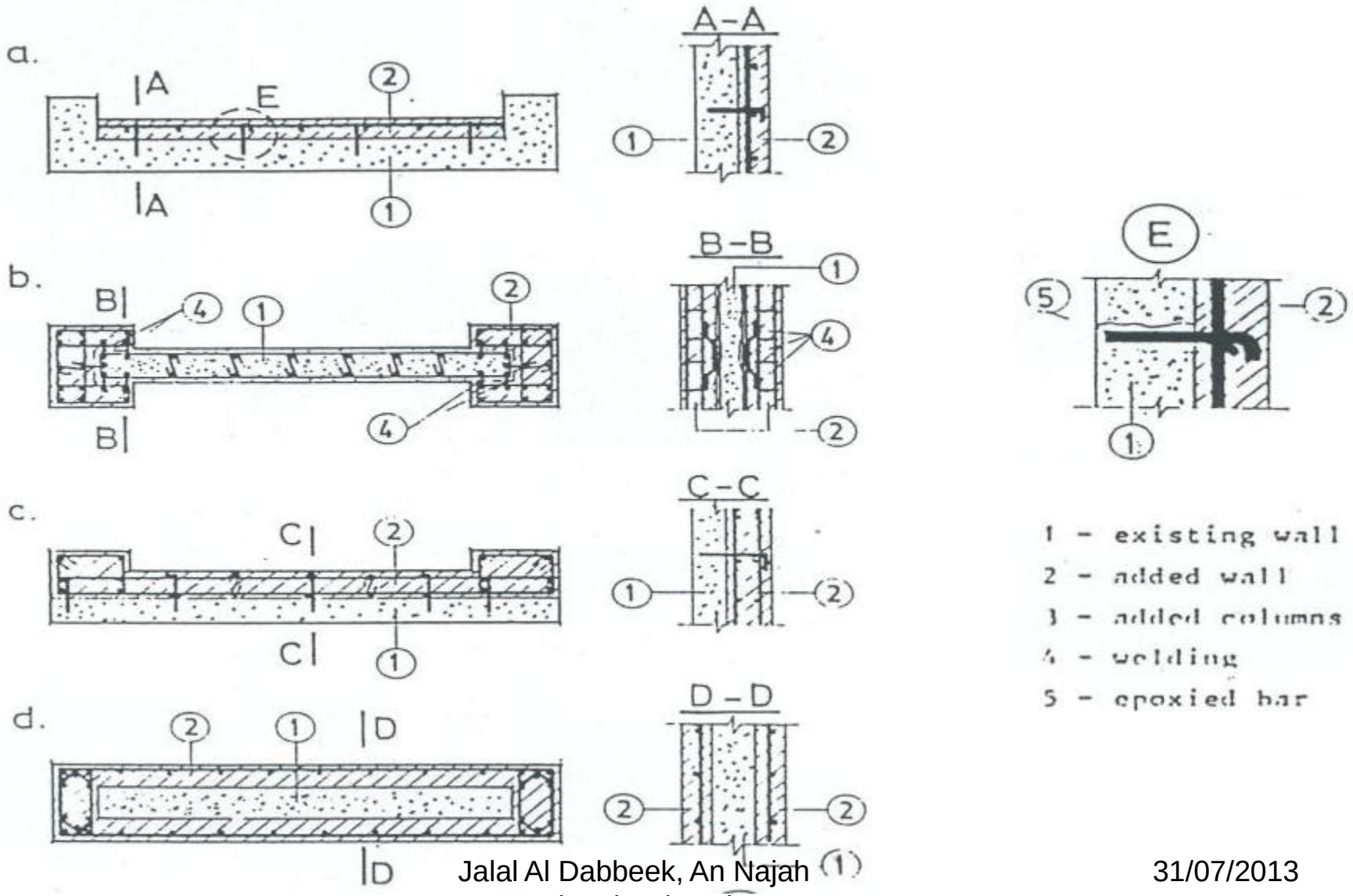
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C–C
1
2
d.
2
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D
D–D
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2
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E
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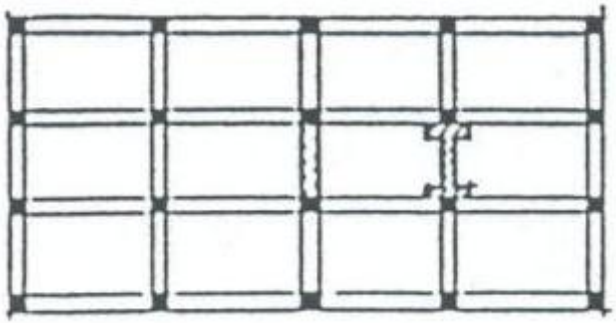
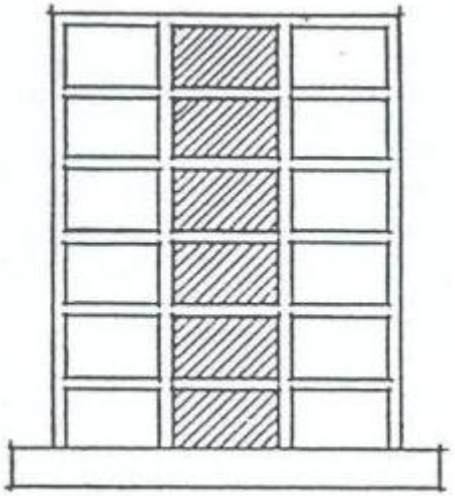
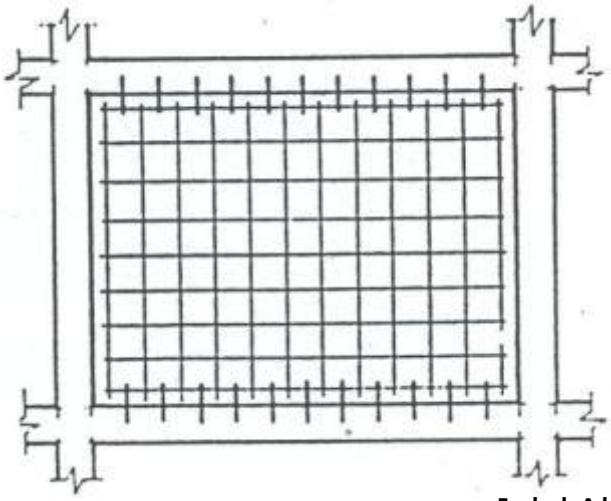
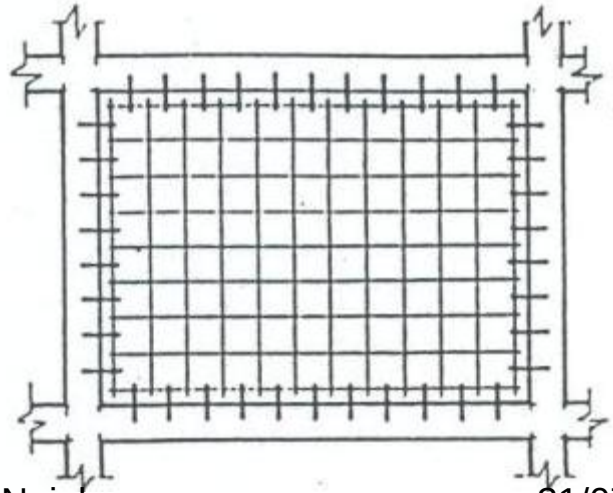
2
1
1 – existing wall
2 – added wall
3 – added columns
4 – welding
5 – epoxied bar

Infilled Walls









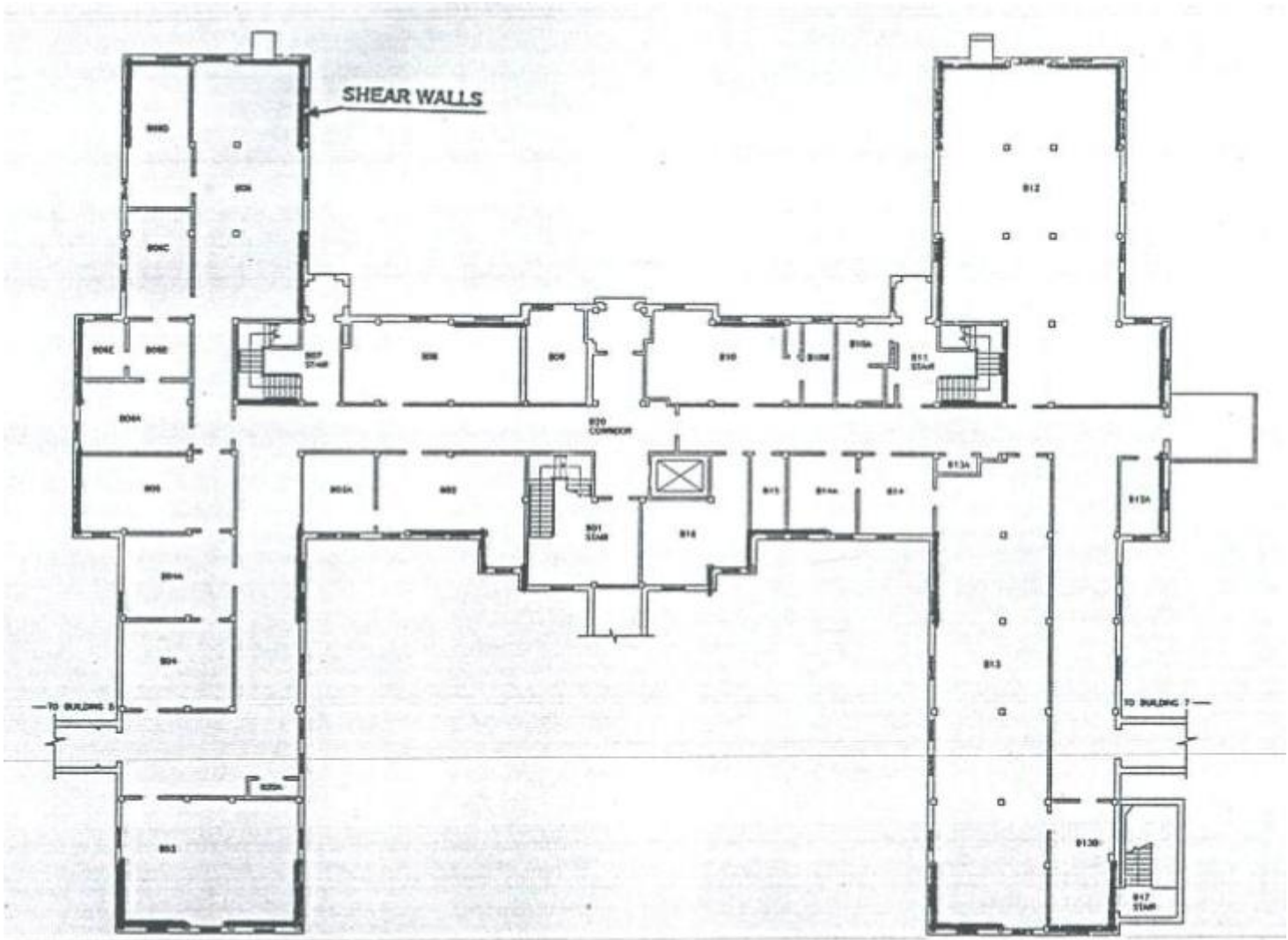
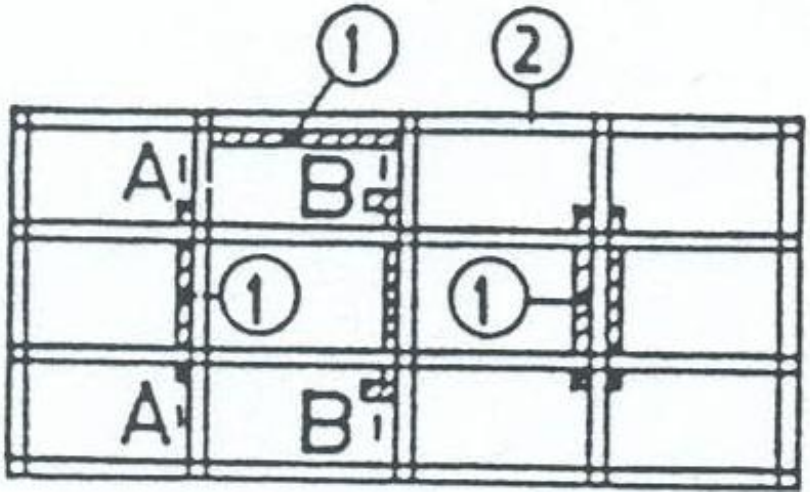
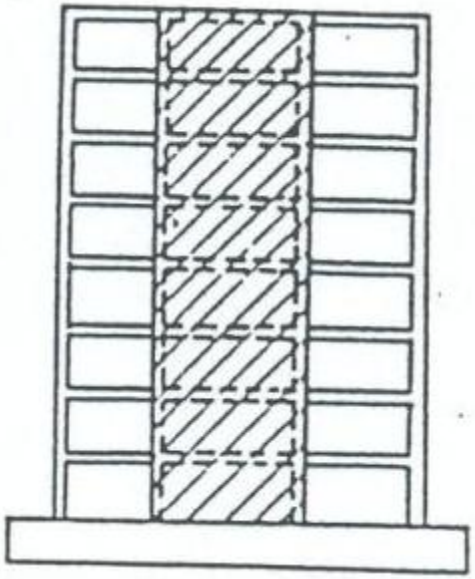
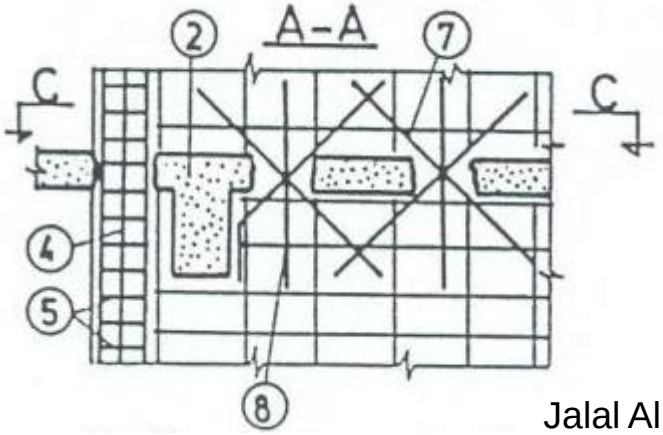


Fig. —Building #6 scheme : peripheral shear walls

Shear Walls

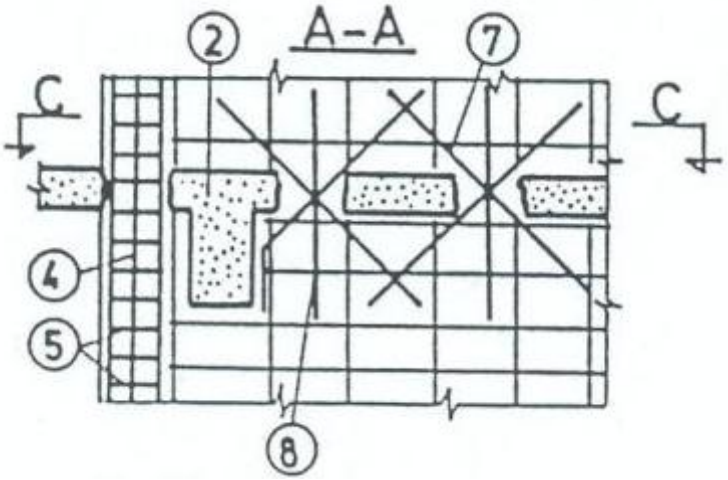




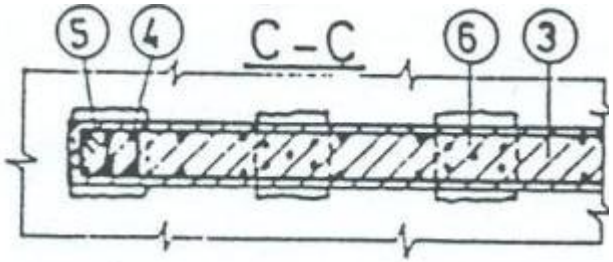


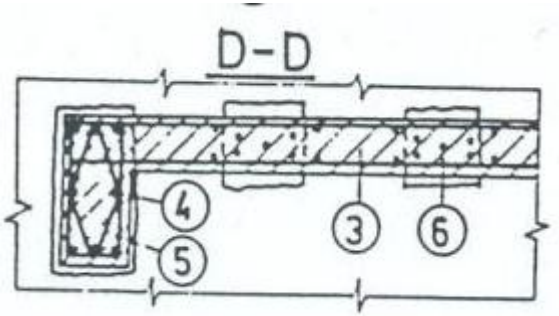
1 - added shear wall
2 - existing structure
3 - added concrete
4 - added reinforcement
5 - added ties
6 - dowel
7 - added diagonal bars
8 - added vertical bars

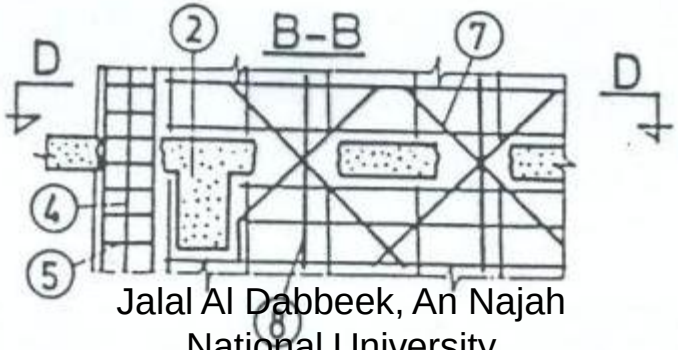
Shear Walls

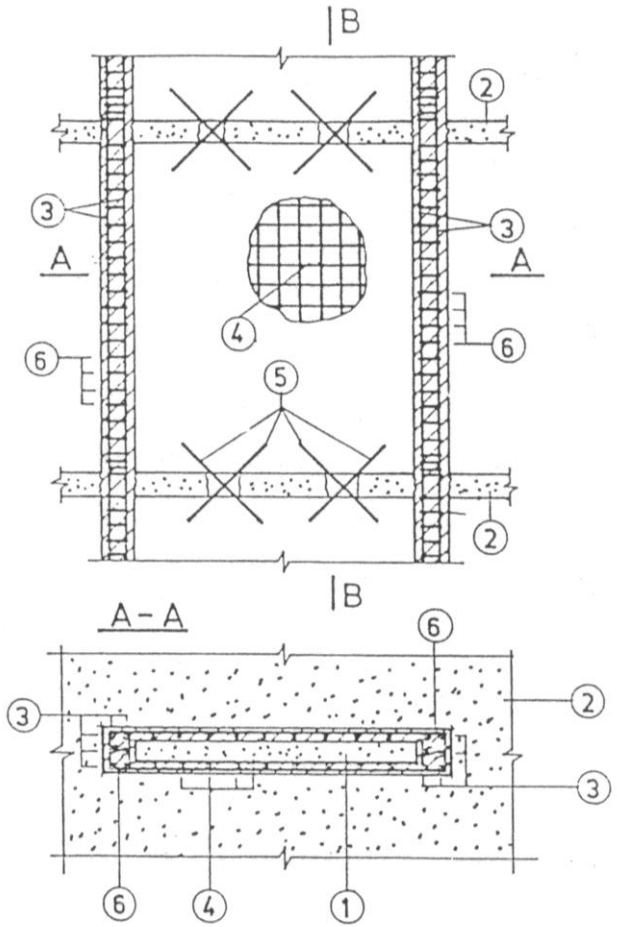


1 - added shear wall
2 - existing structure
3 - added concrete
4 - added reinforcement
5 - added ties
6 - dowel
7 - added diagonal bars
8 - added vertical bars



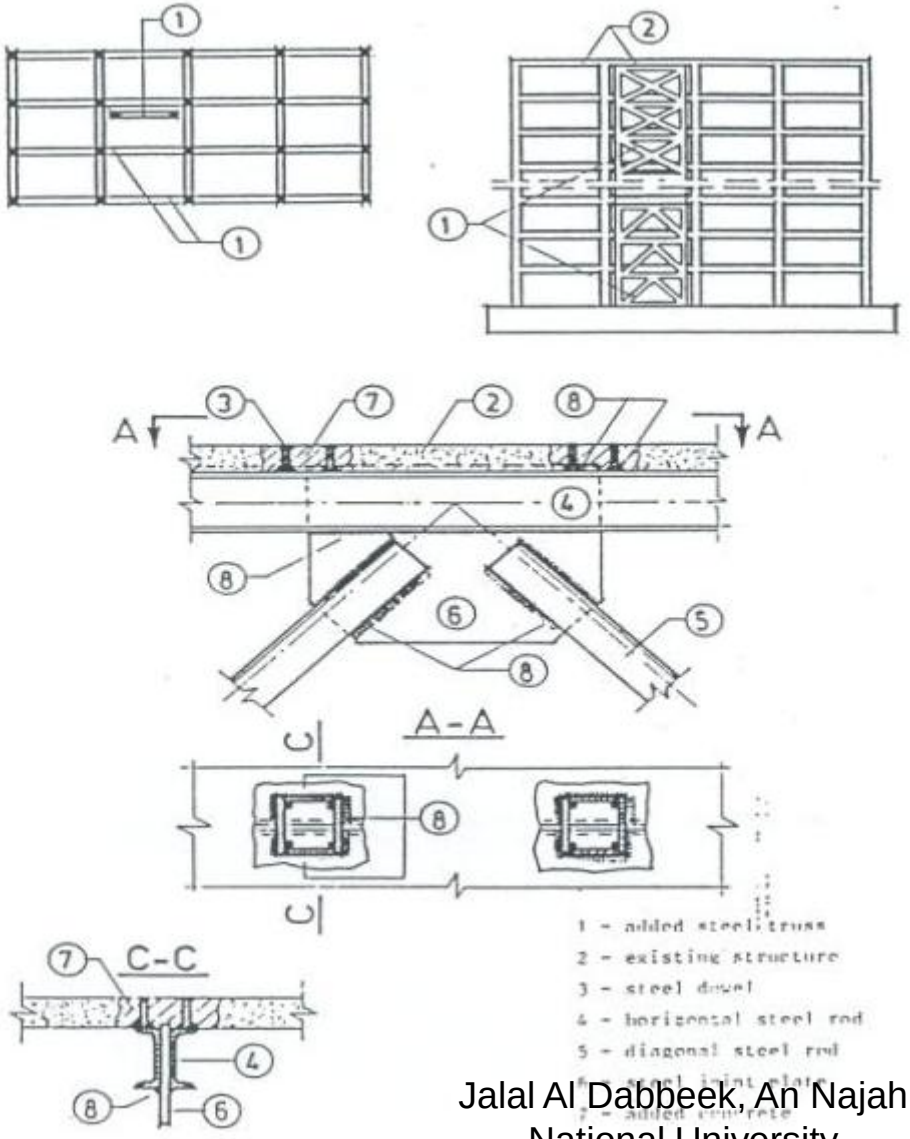






1 - existing wall; 2 - existing slab; 3 - added longitudinal reinforcement; 4 - added wire fabric; 5 - diagonal connecting bars; 6 - added ties

Diagonal Bracing



الطابق الرخو

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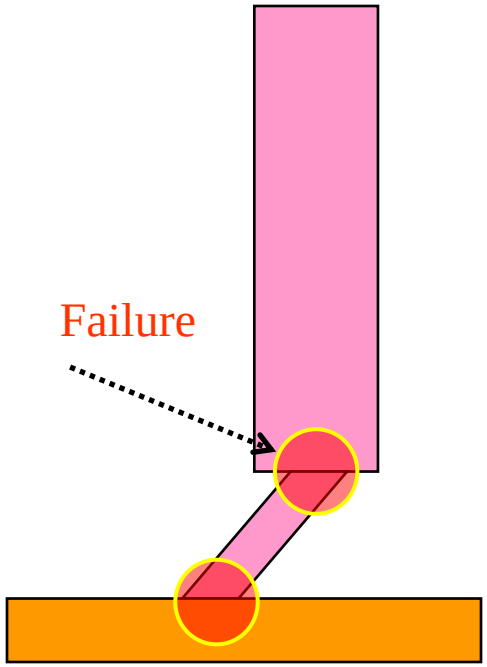
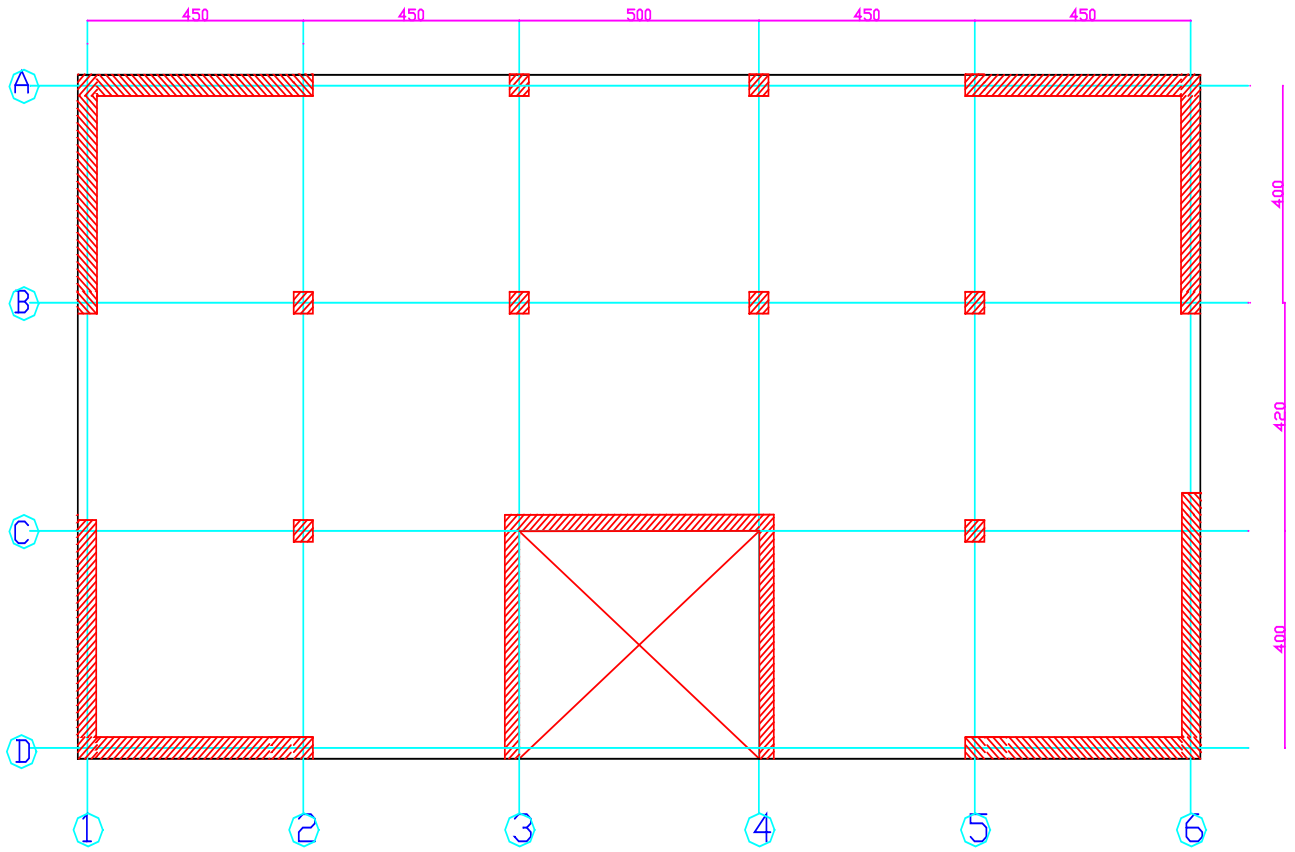
SOFT-FIRST-STORY BUILDINGS

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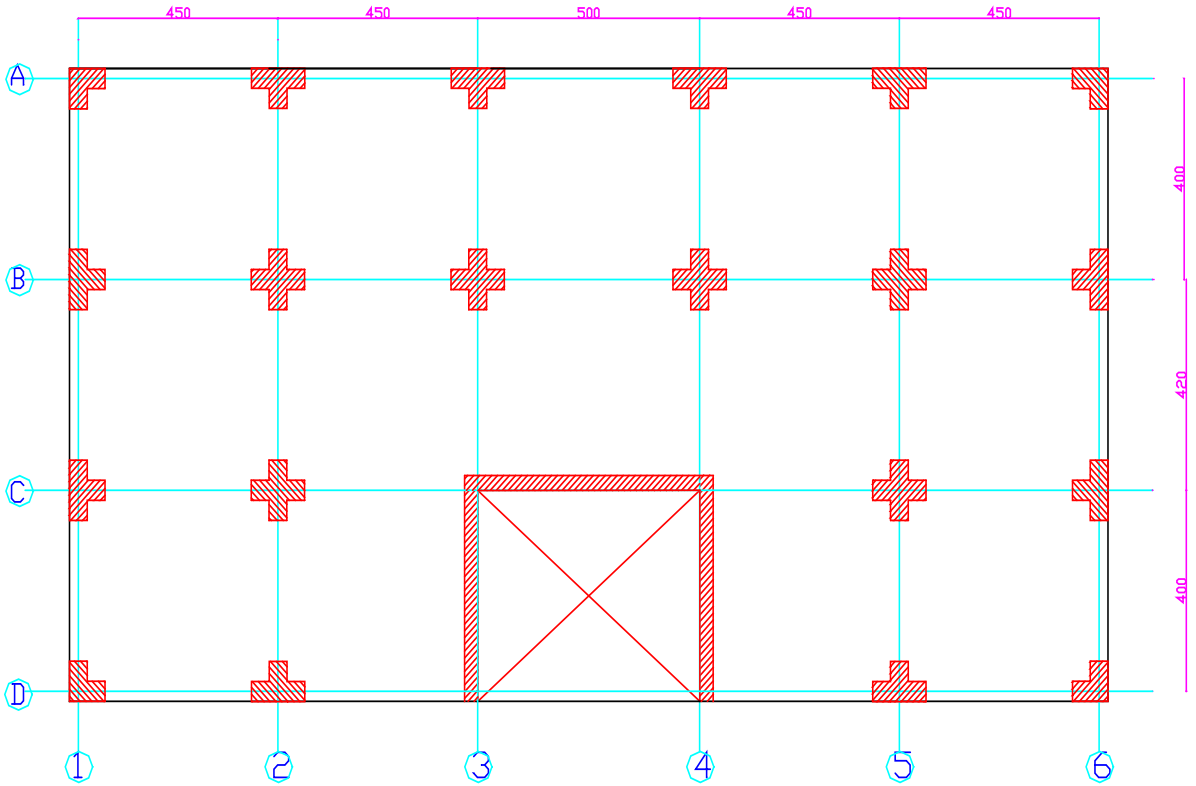
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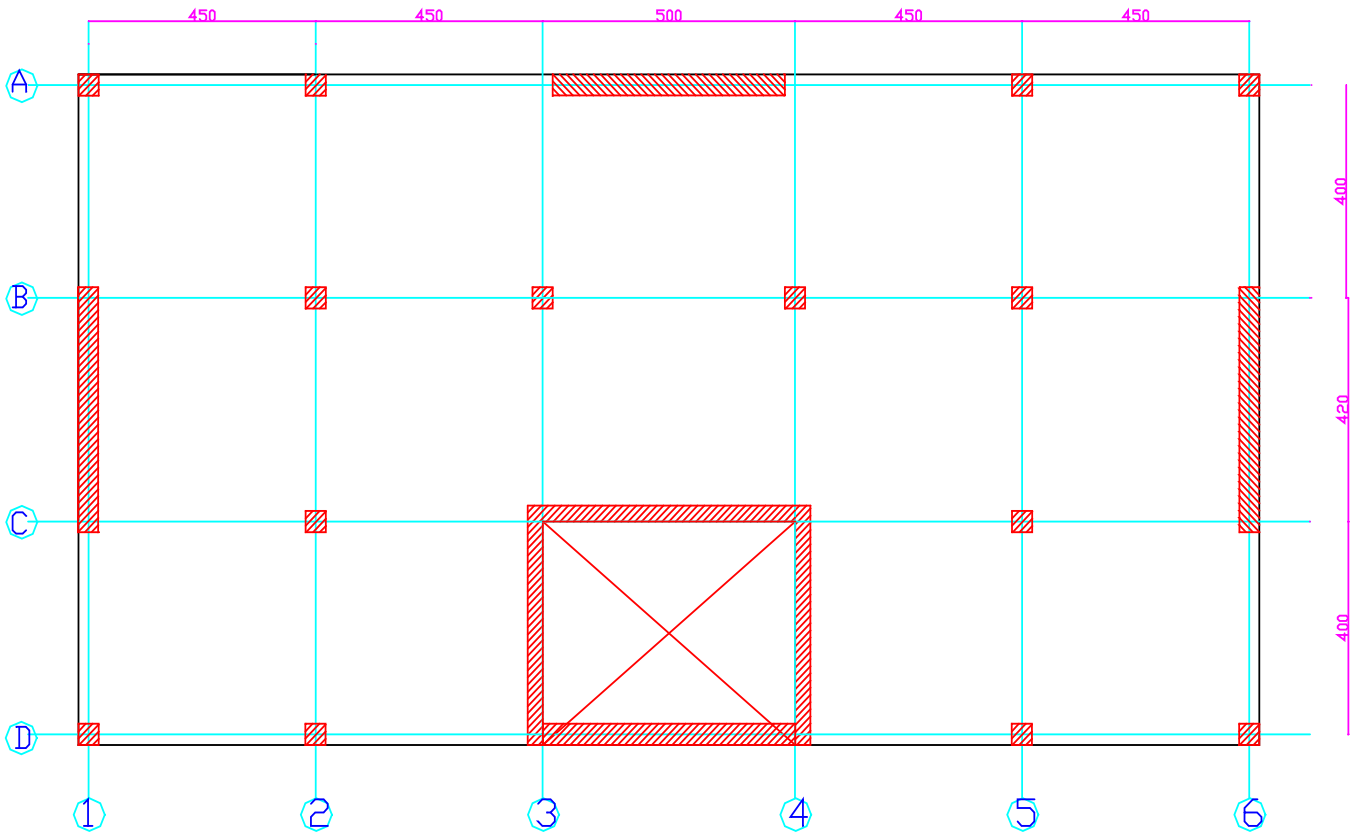
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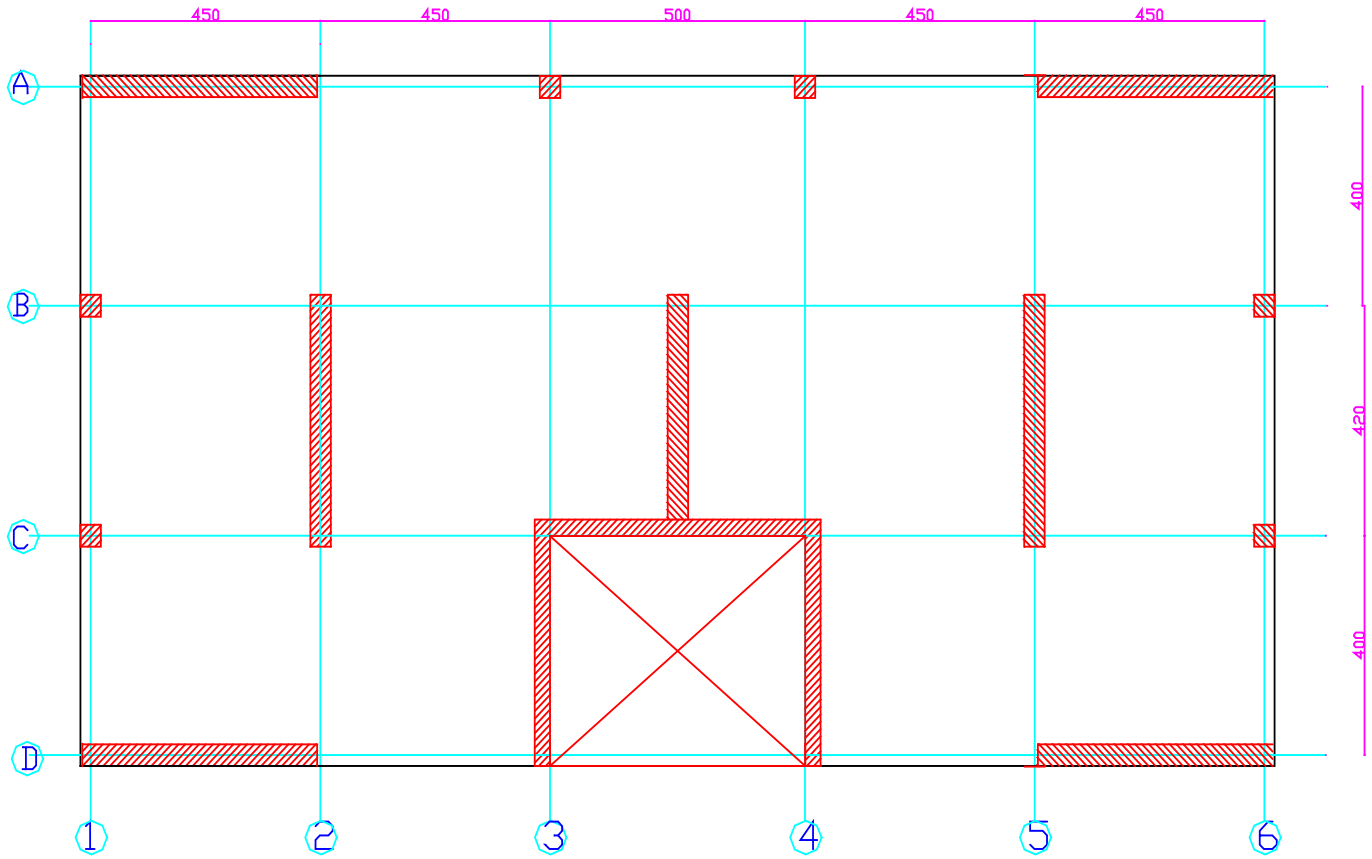
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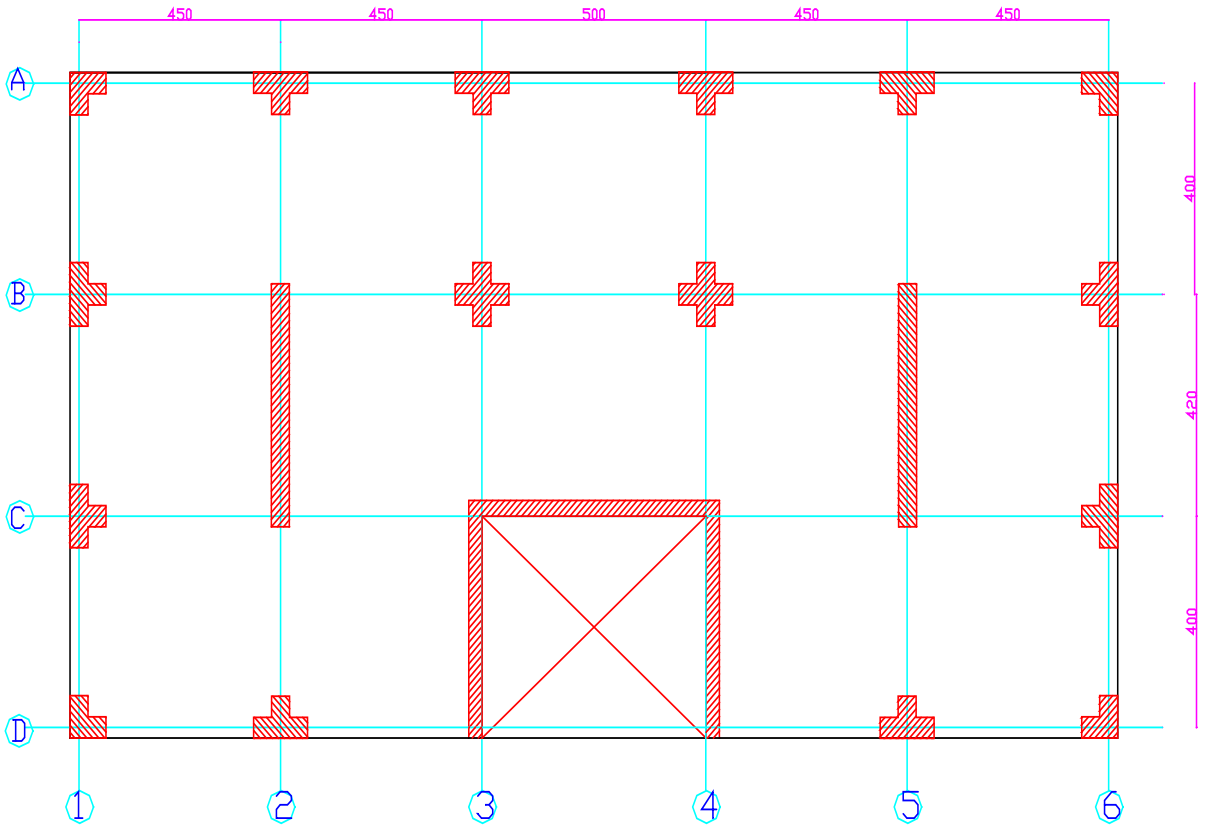
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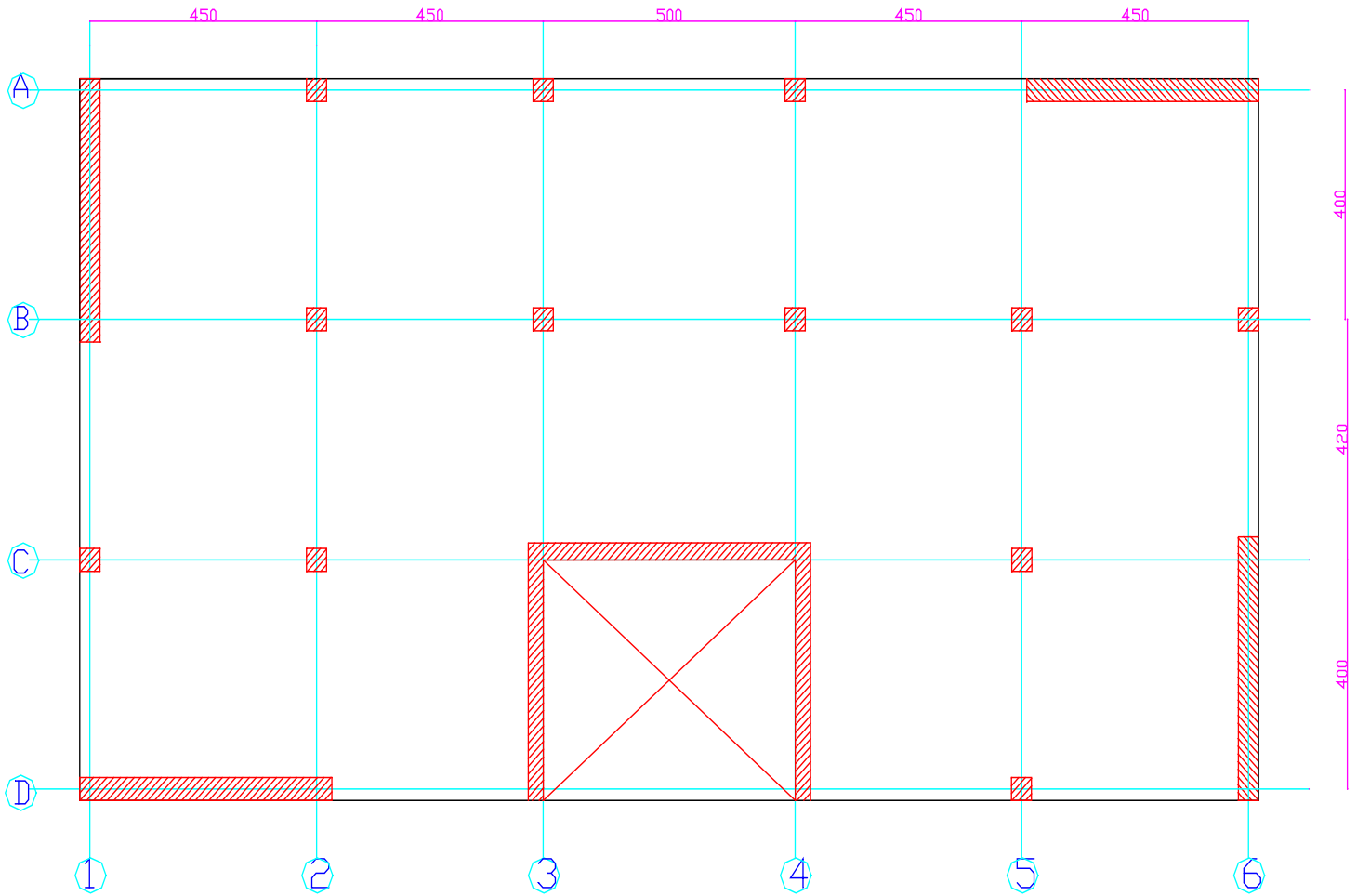
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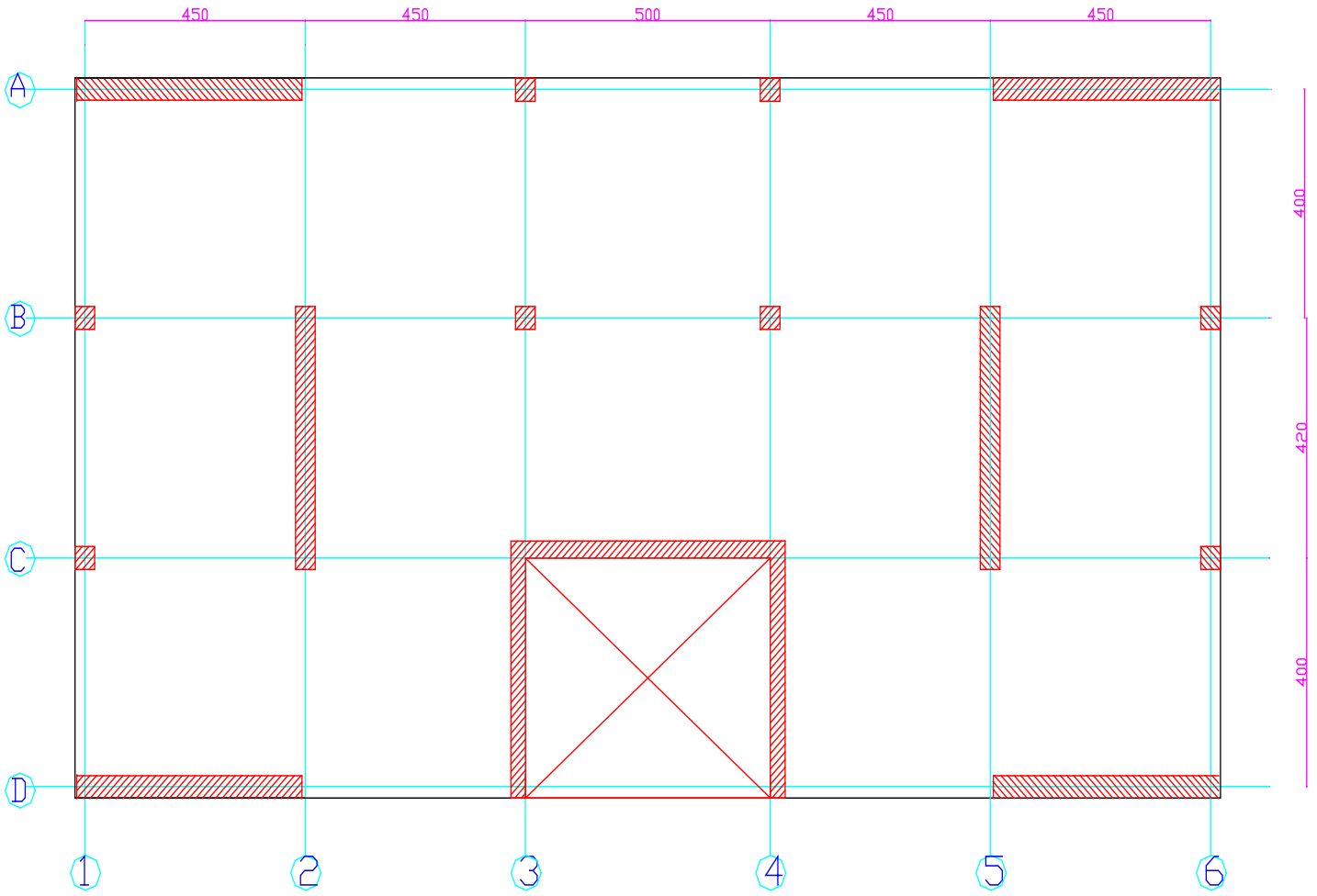
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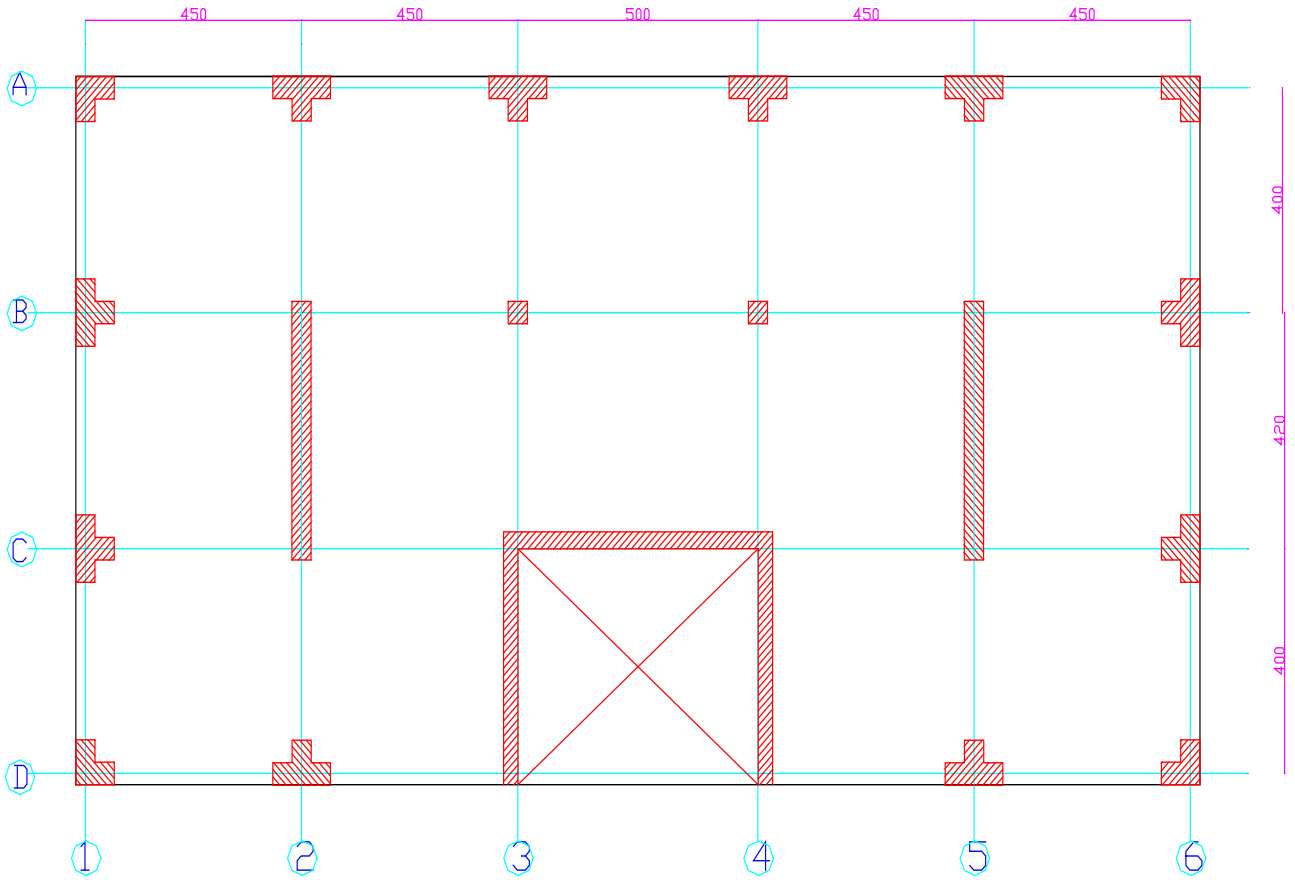
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الدرج وسط المبنى

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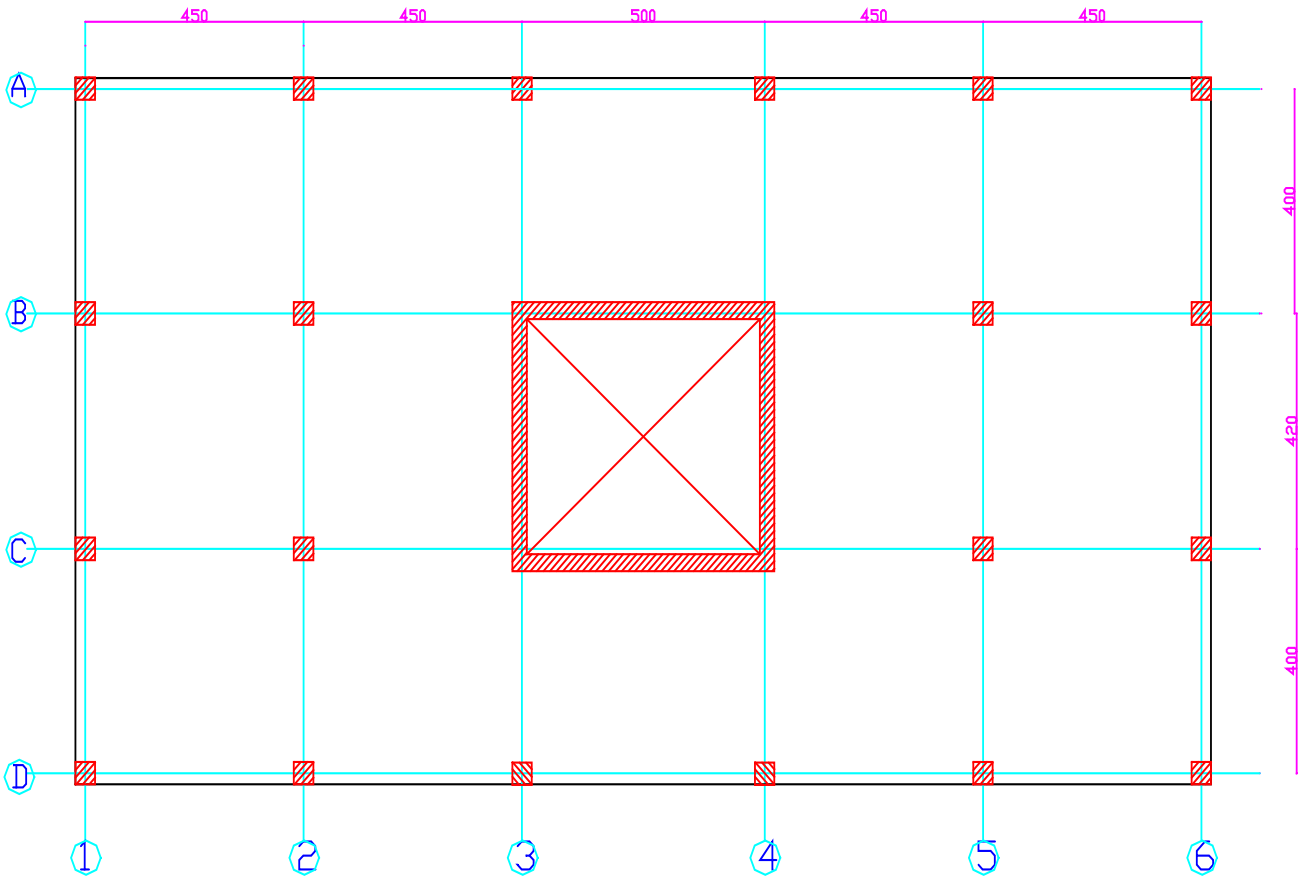
31/07/2013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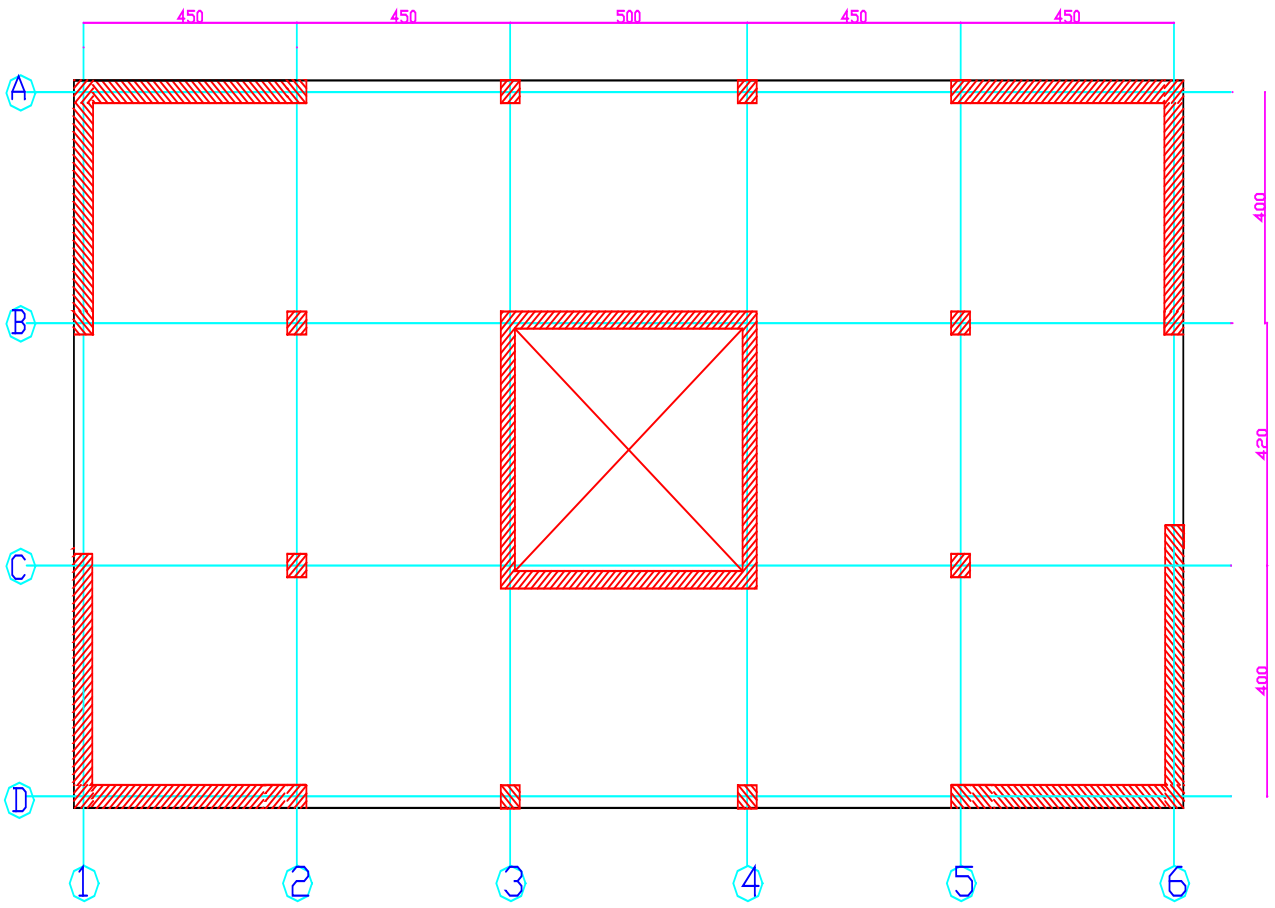
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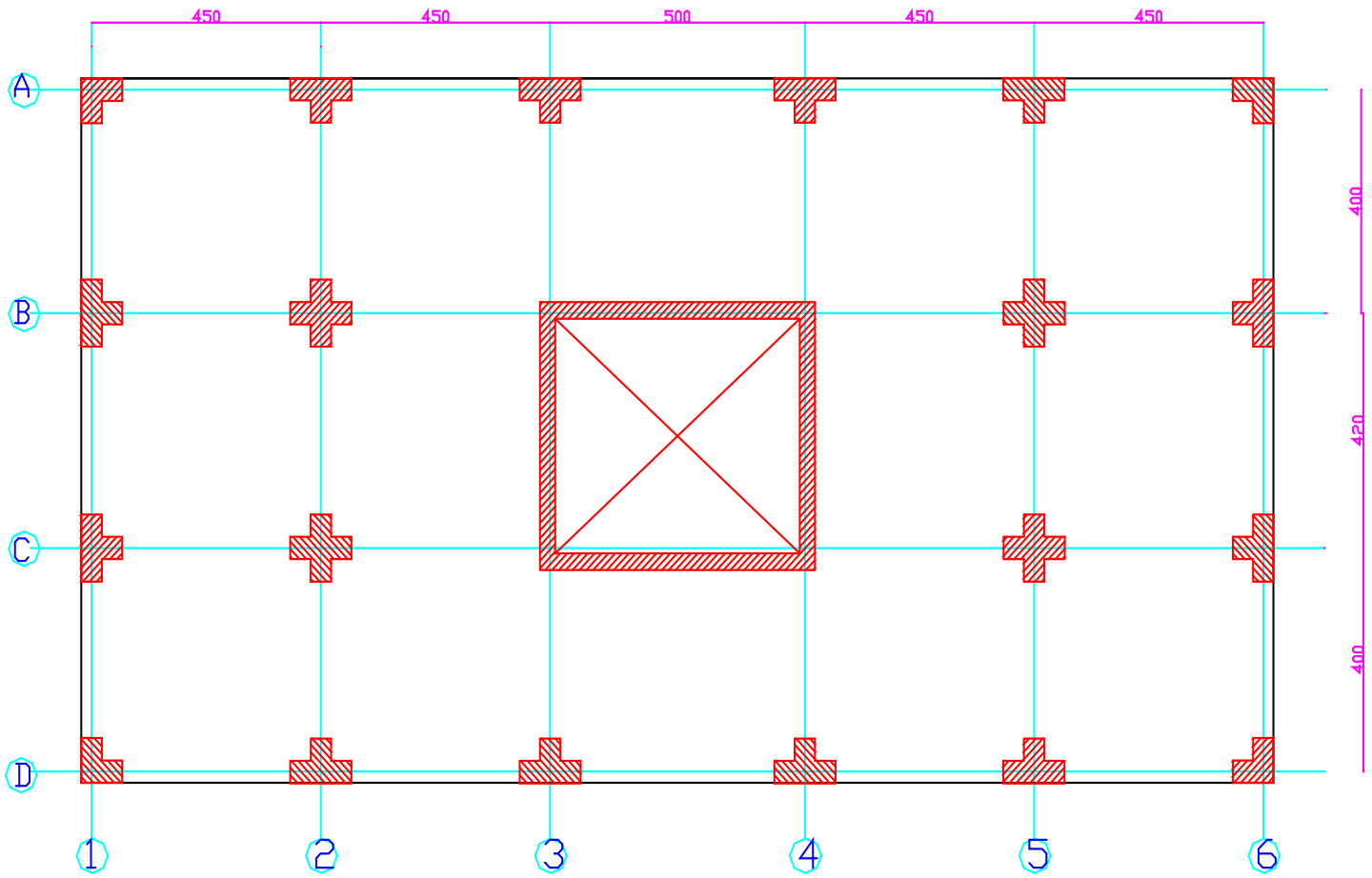
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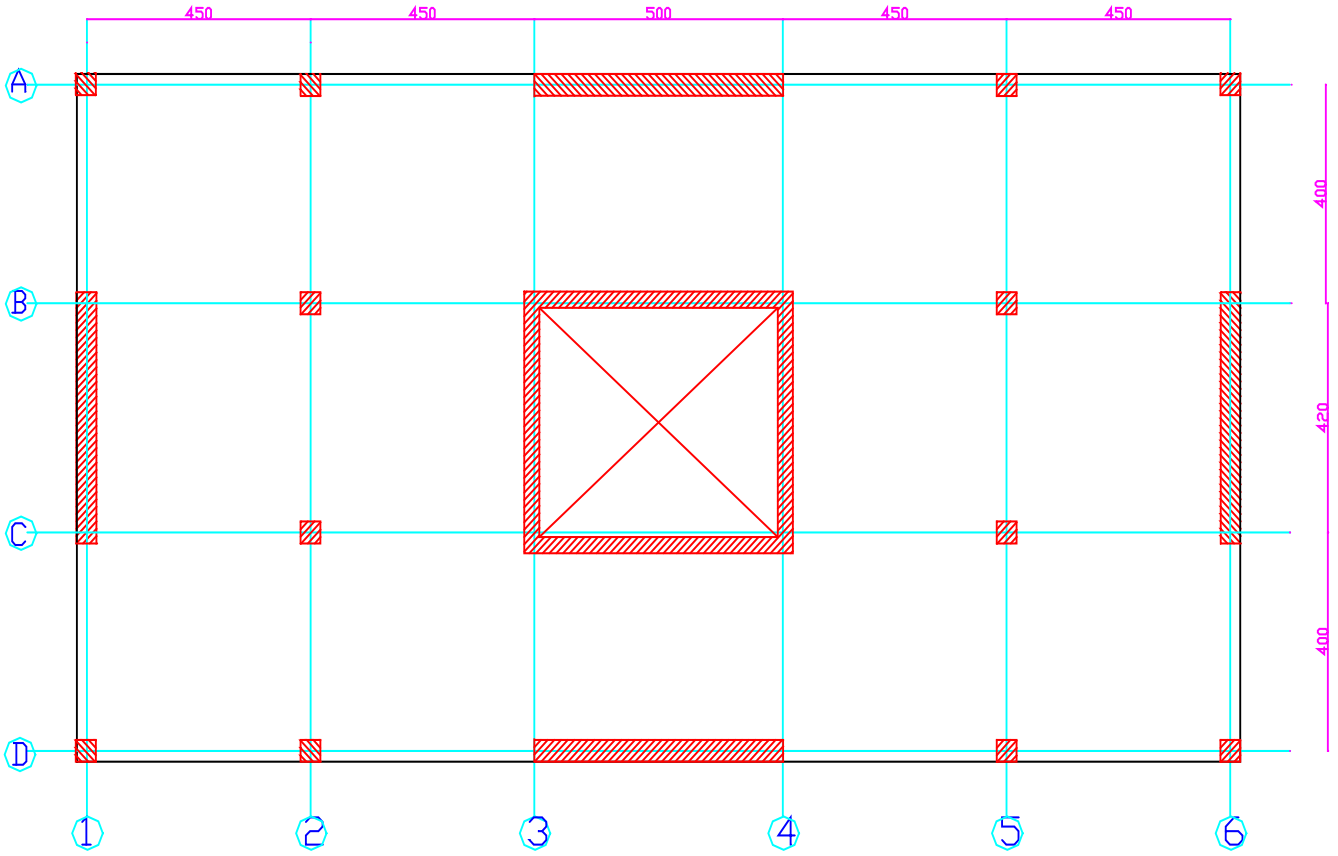
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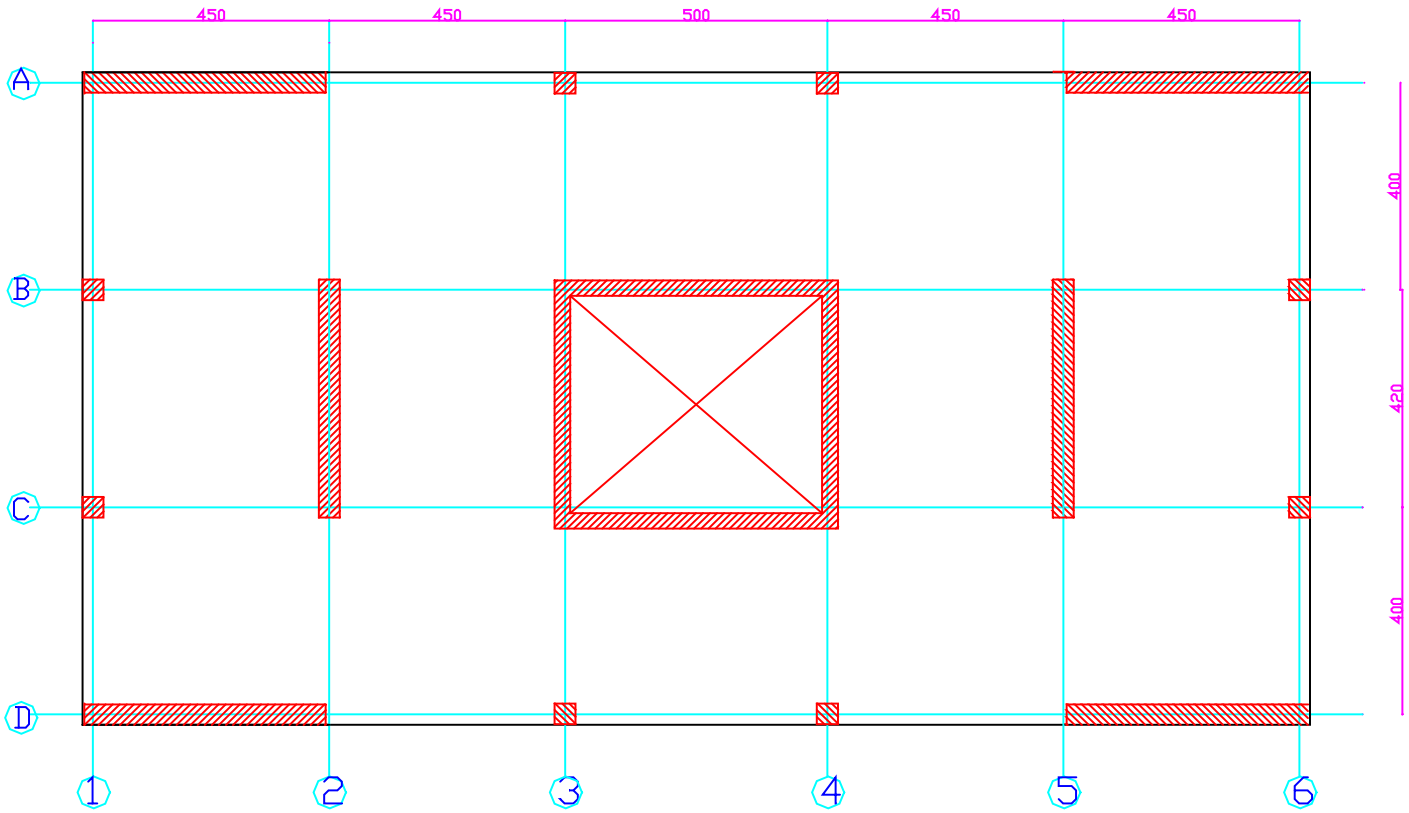
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400
420
400
A
B
C
D
1
2
3
4
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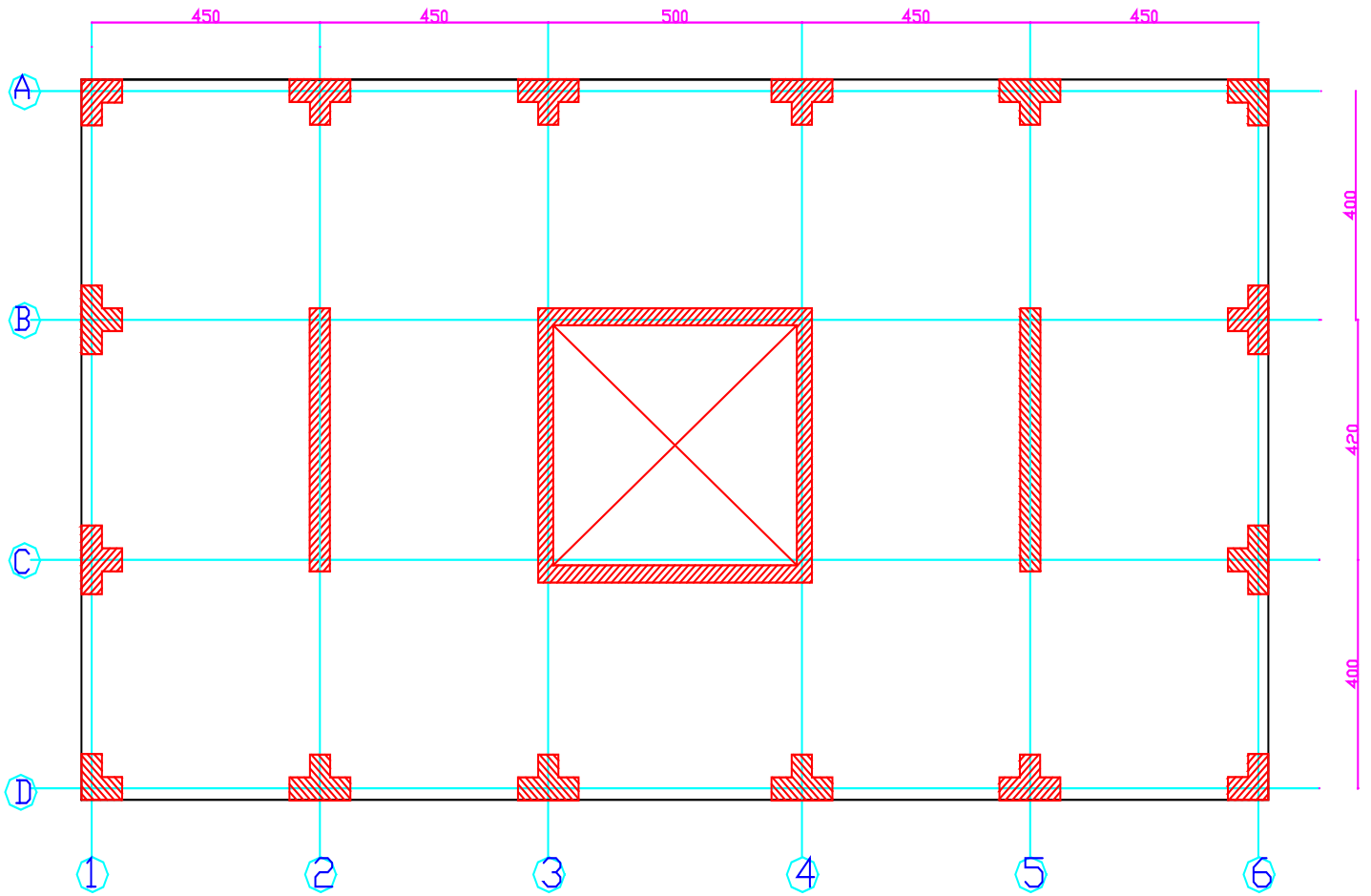
6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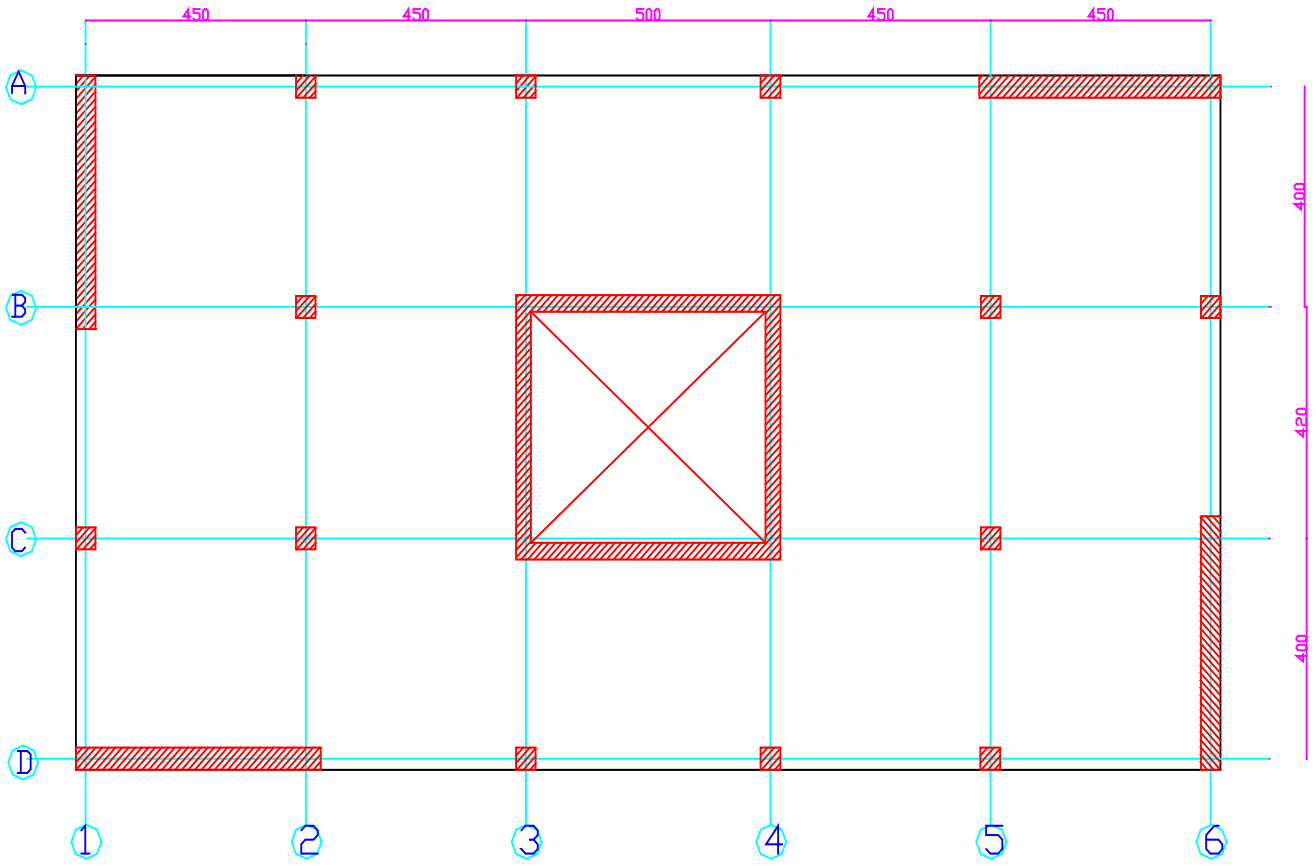
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C
D
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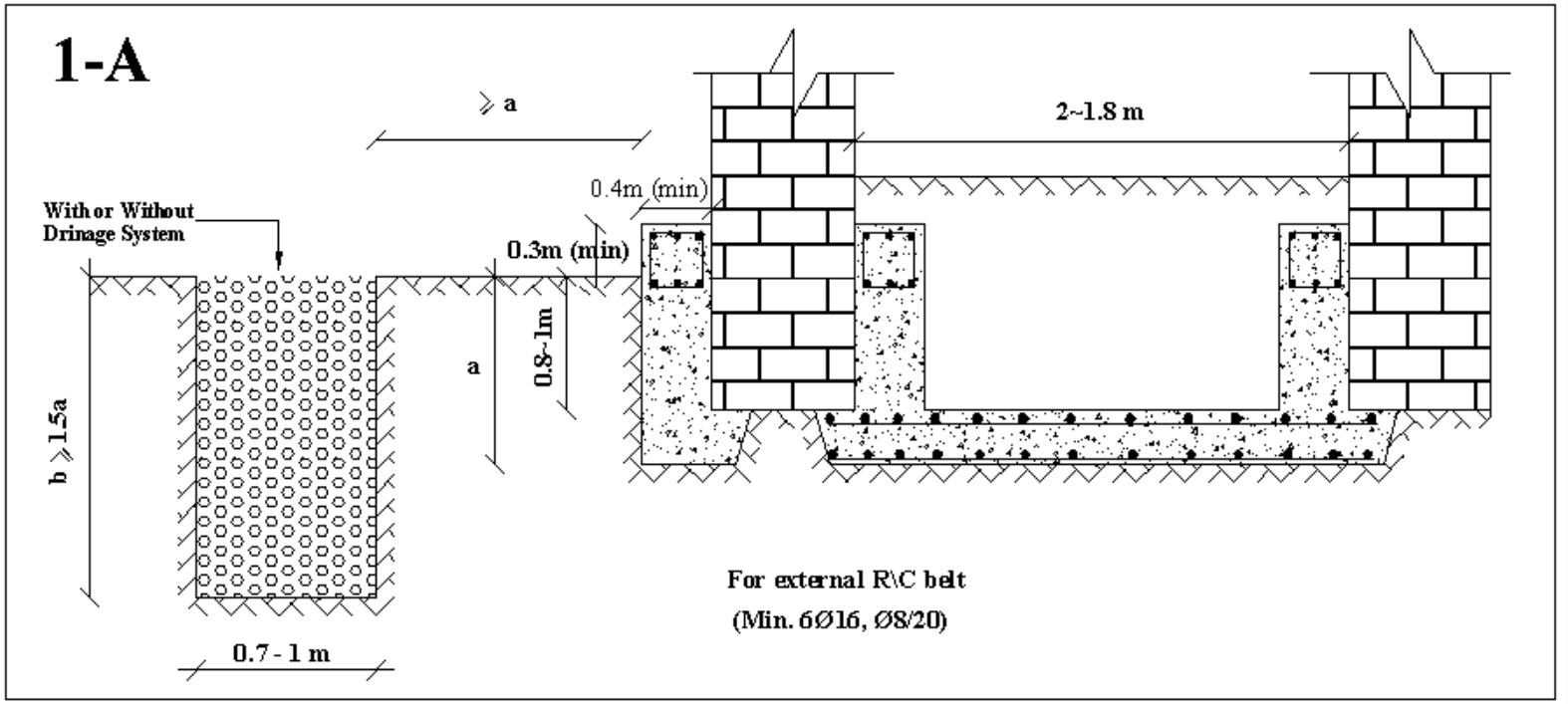
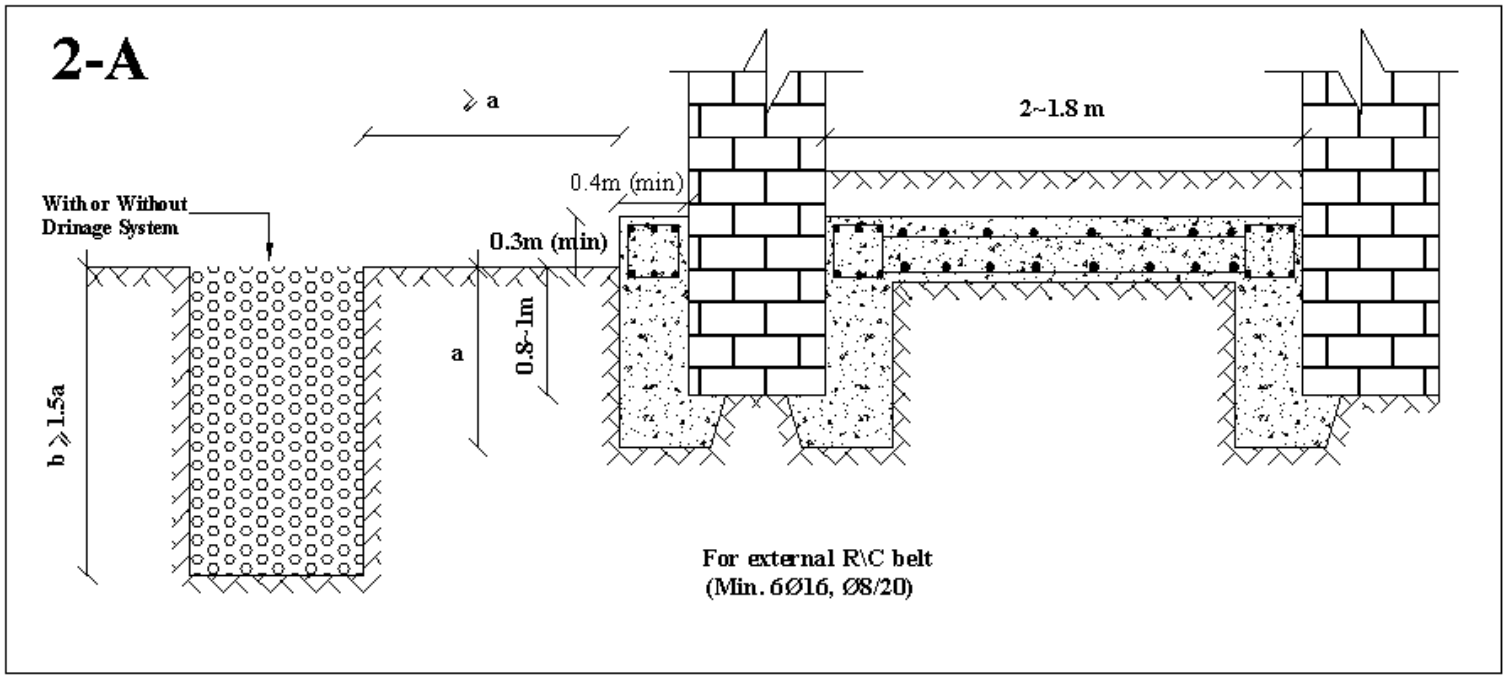
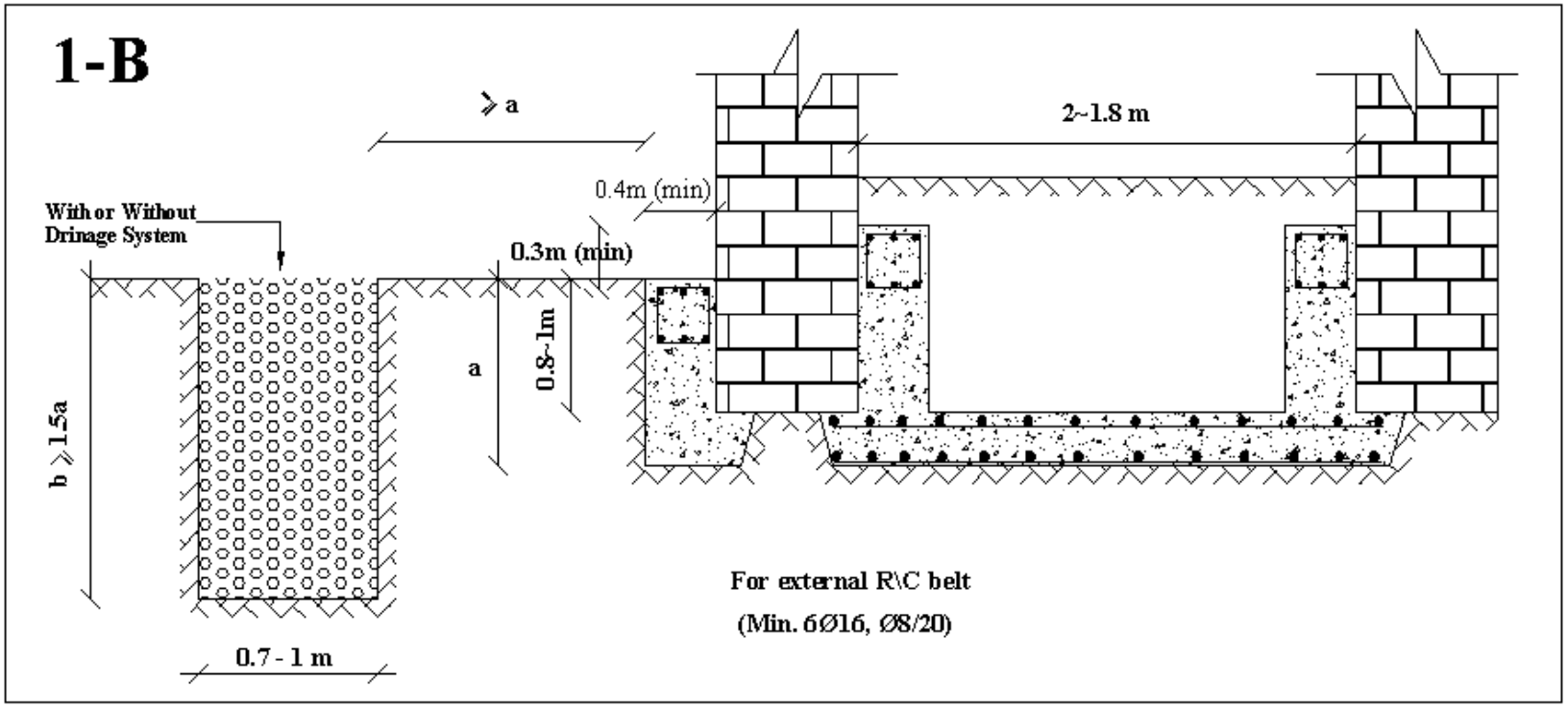
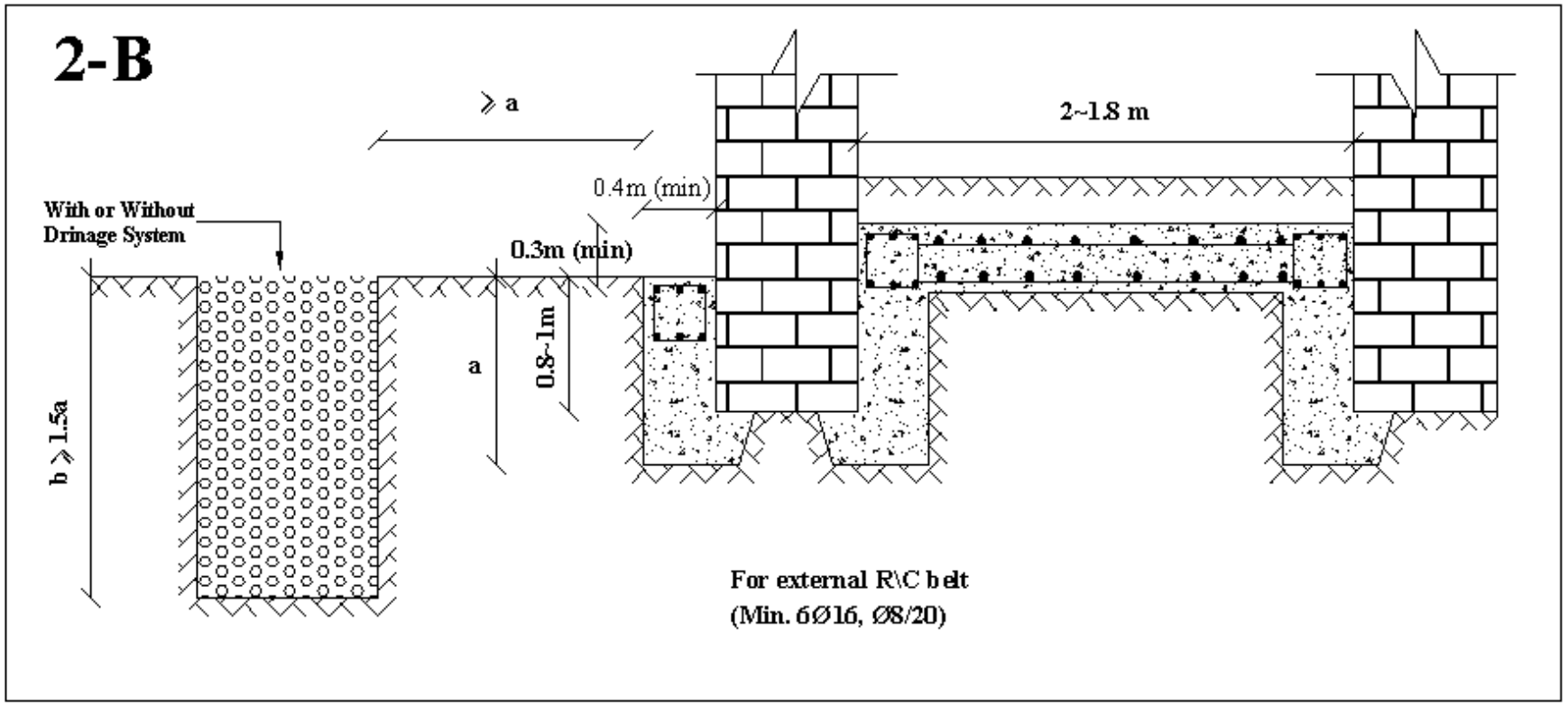
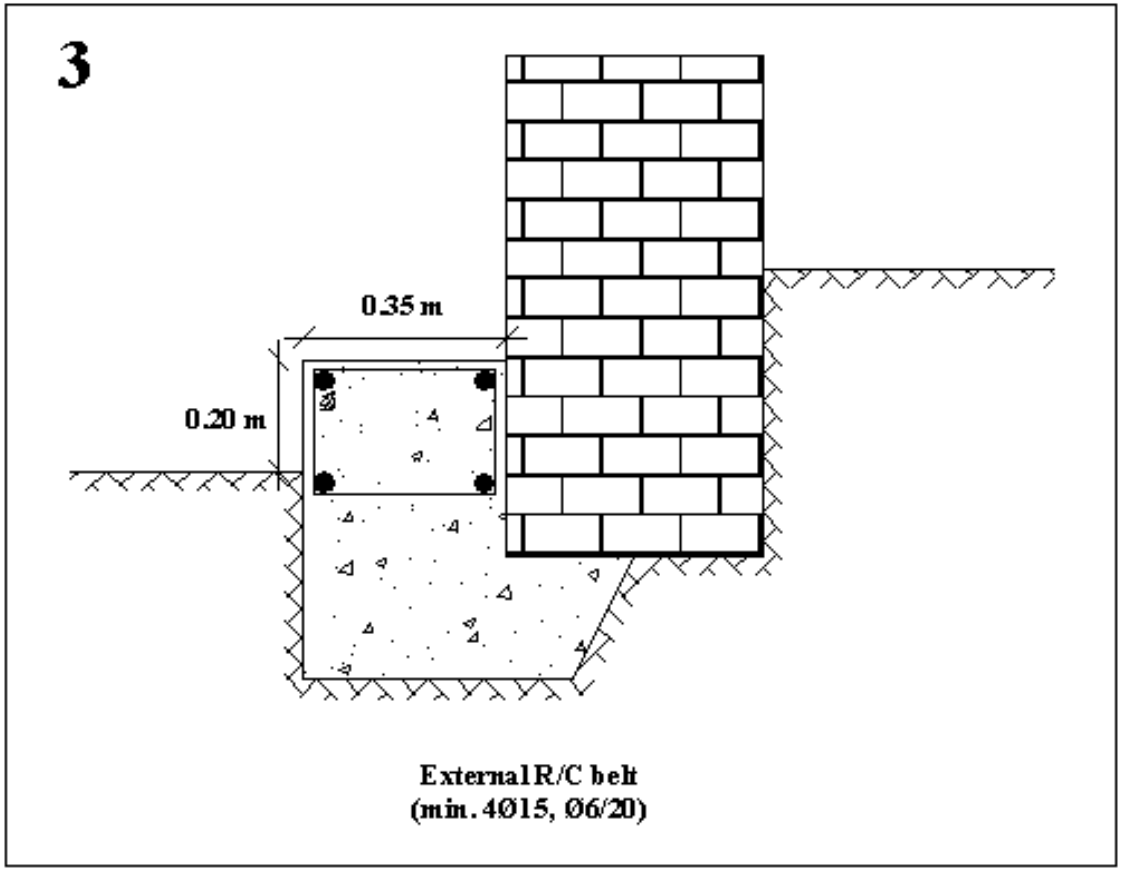
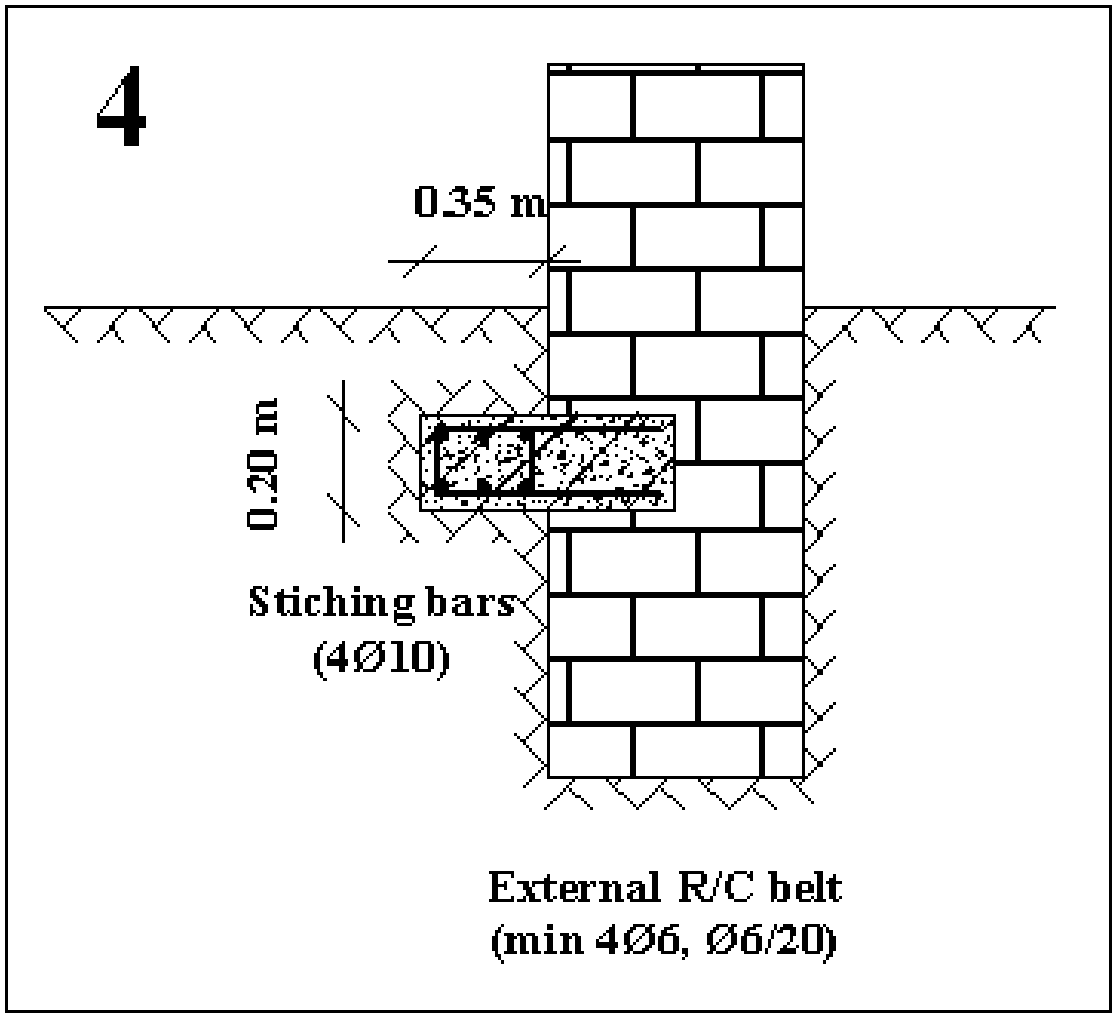

1-A
⩾ a
2~1.8 m
0.4m (min)
With or Without
Drinage System
0.3m (min)
a
0.8~1m
b ⩾ 1.5a
For external R\C belt
(Min. 6Ø16, Ø8/20)
0.7 - 1 m

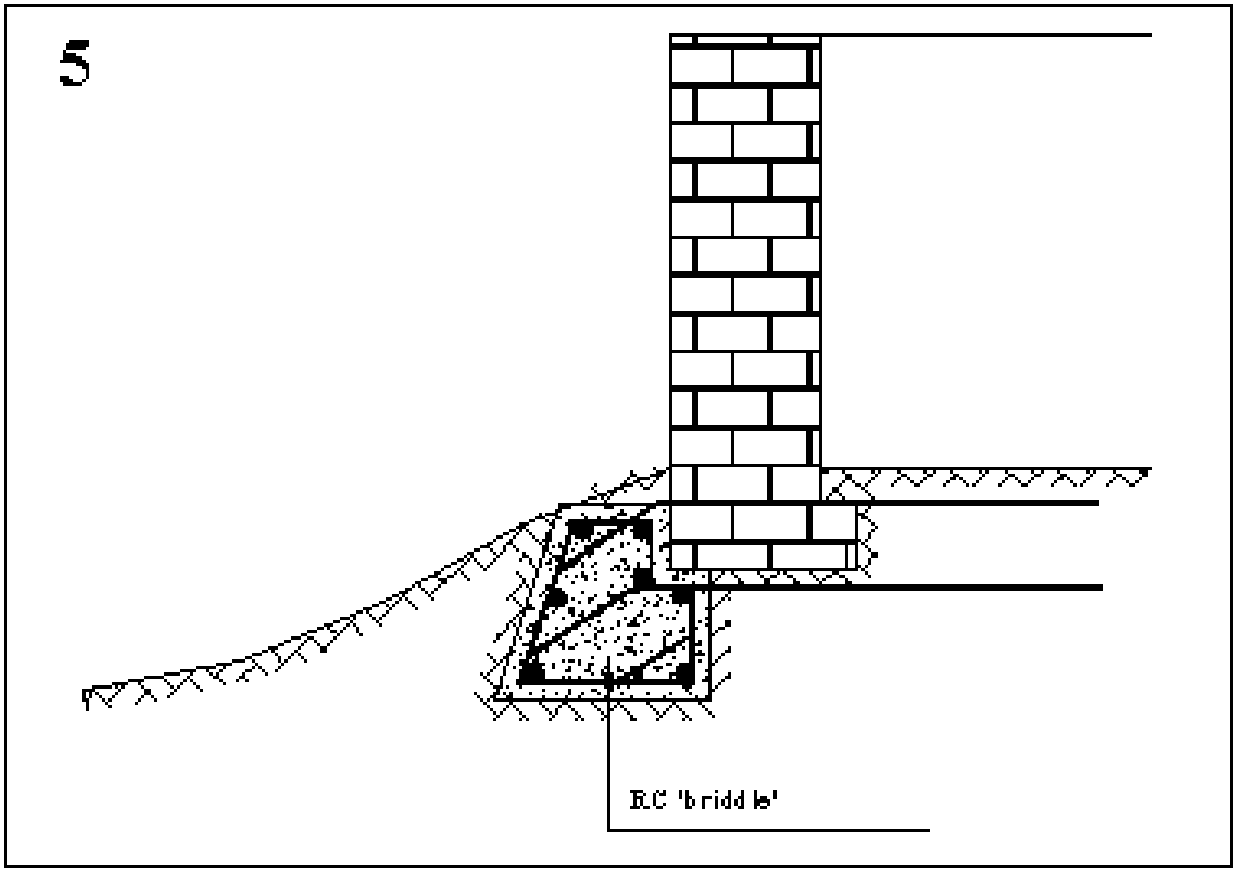

2-A
⩾ a
2~1.8 m
0.4m (min)
With or Without
Drinage System
0.3m (min)
a
0.8~1m
b ⩾ 1.5a
For external R\C belt
(Min. 6Ø16, Ø8/20)

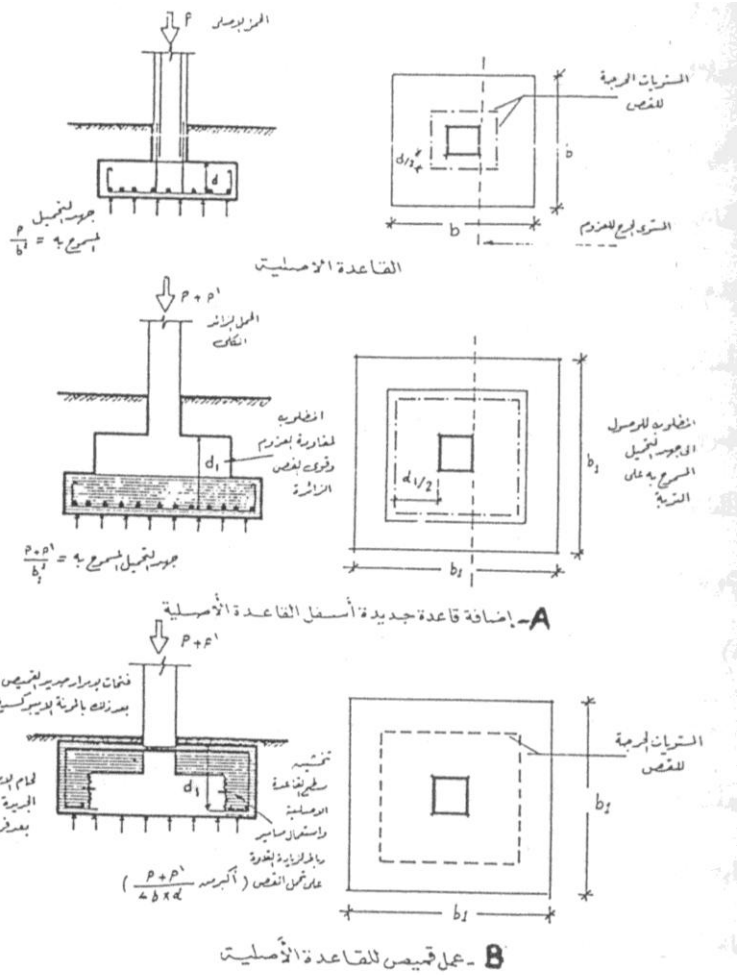

1-B
⩾ a
2~1.8 m
0.4m (min)
With or Without
Drinage System
0.3m (min)
a
0.8~1m
b ⩾ 1.5a
For external R\C belt
(Min. 6Ø16, Ø8/20)
0.7 - 1 m


2-B
⩾ a
2~1.8 m
0.4m (min)
With or Without
Drinage System
0.3m (min)
a
0.8~1m
b ⩾ 1.5a
For external R\C belt
(Min. 6Ø16, Ø8/20)


3
0.35 m
0.20 m
External R/C belt
(min. 4Ø15, Ø6/20)


4
0.35 m
0.20 m
Stiching bars
(4Ø10)
External R/C belt
(min 4Ø6, Ø6/20)


5



الشكل ( ) طرق زيادة قدرة التحميل لقاعدة منفصلة (المصدر A 8).

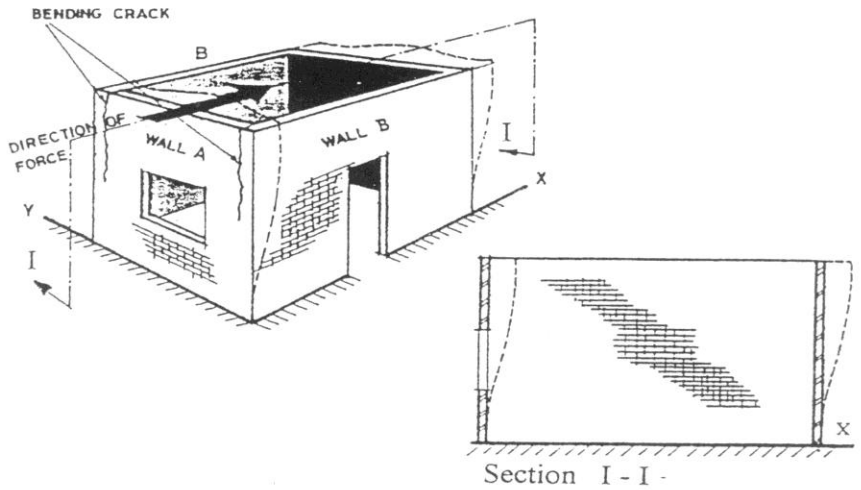


Figure 5.1-2 Wall Enclosure without Roof [1]

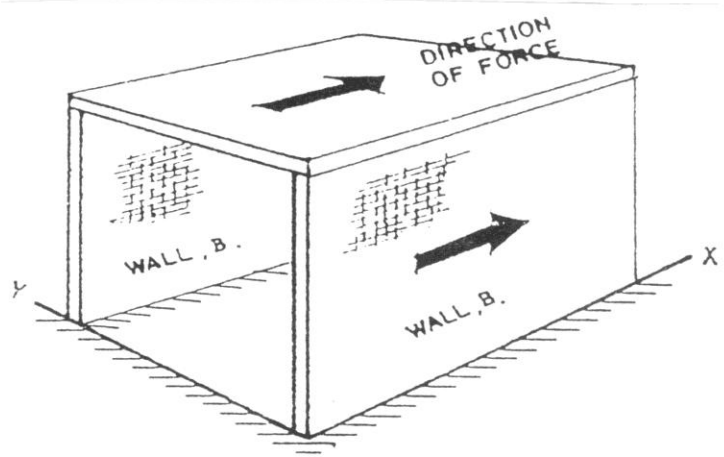


Figure 5.1-3 Roof on Two Walls [1]

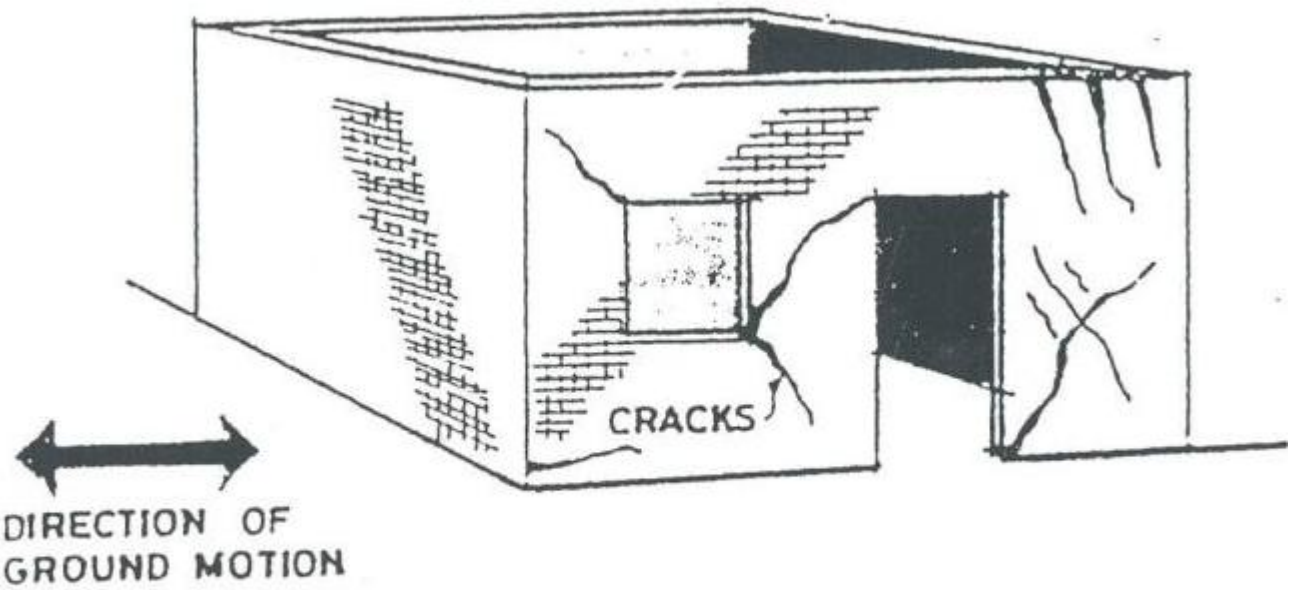


Figure 4.1-2 Cracking in Shear Wall at Corners of Opening

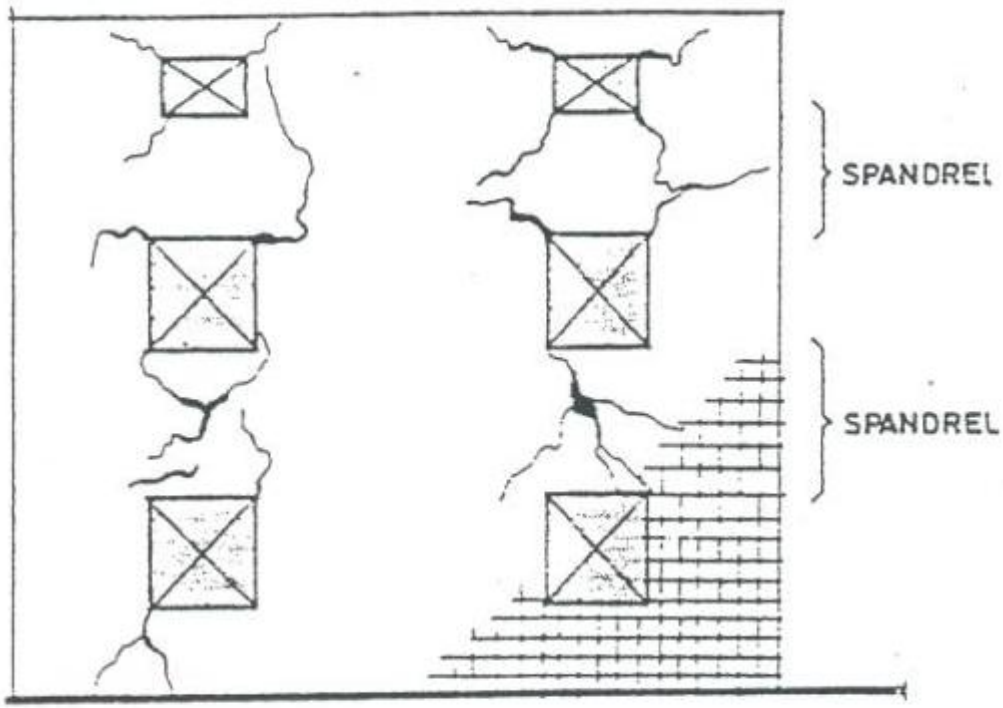


Figure 7.1-2 Cracking of Sprandel Wall between opening

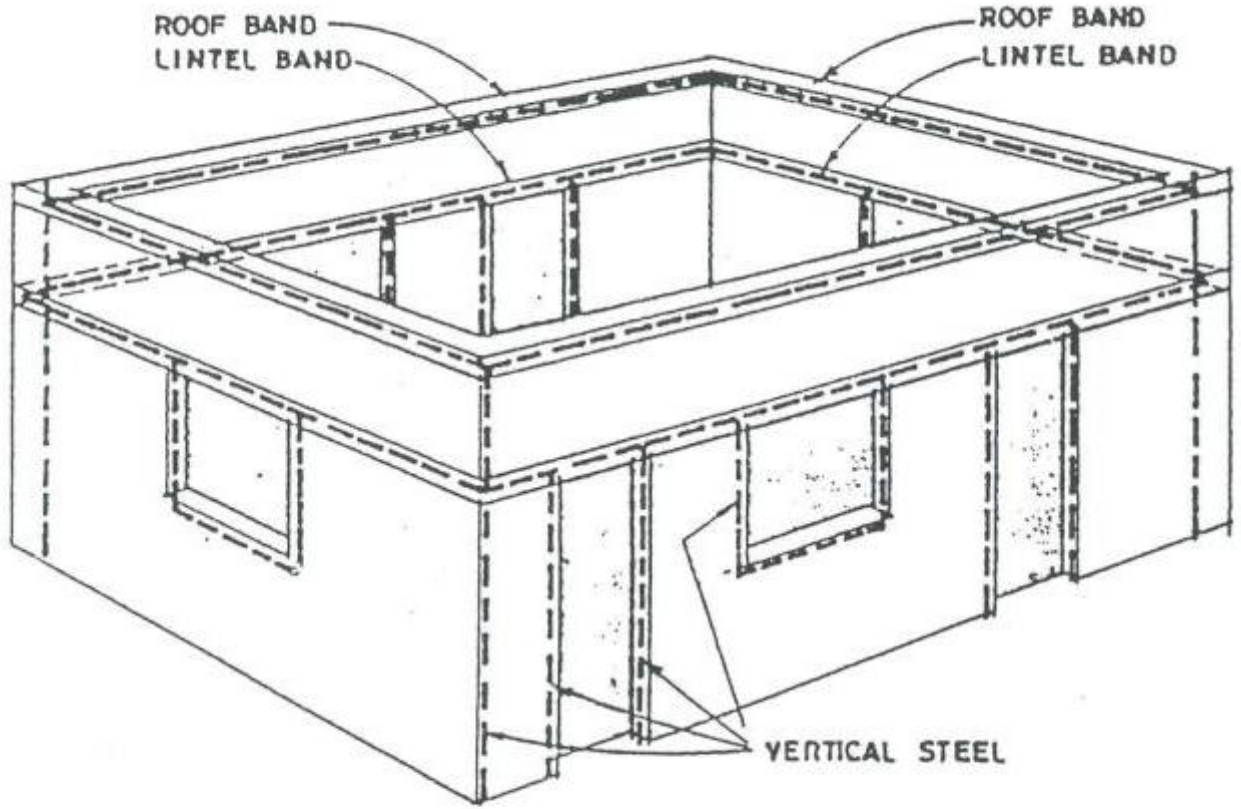


Figure 9.1-5 Gable Band and Roof Band in Barrack Type Building [1]

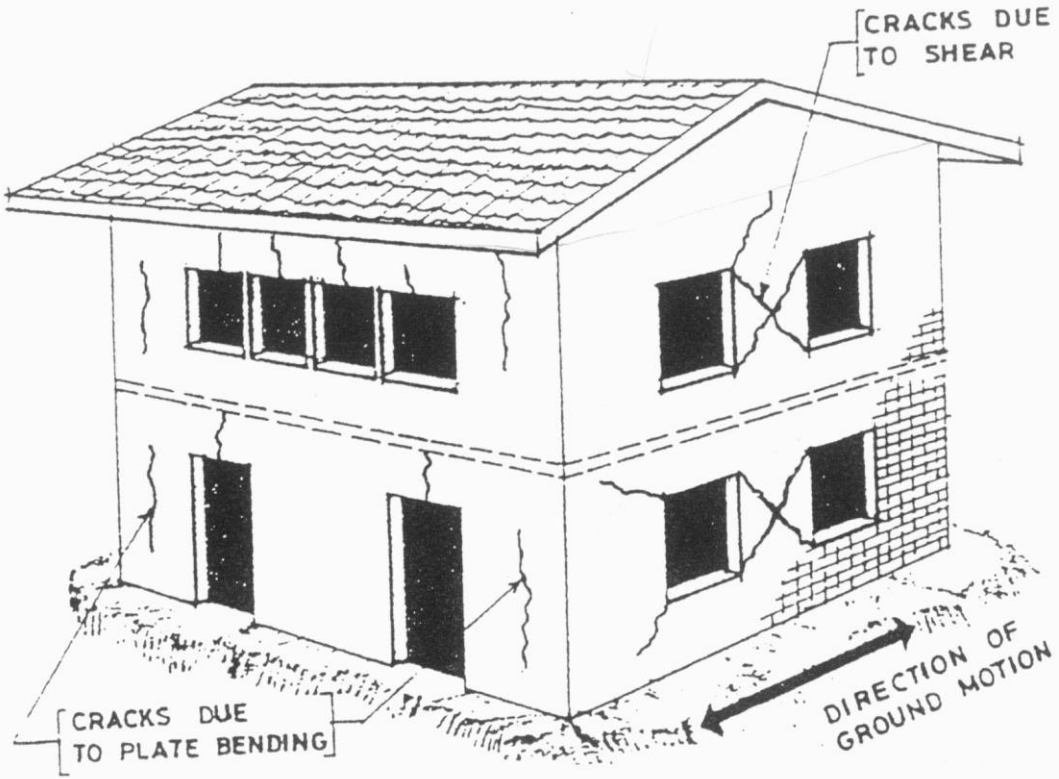
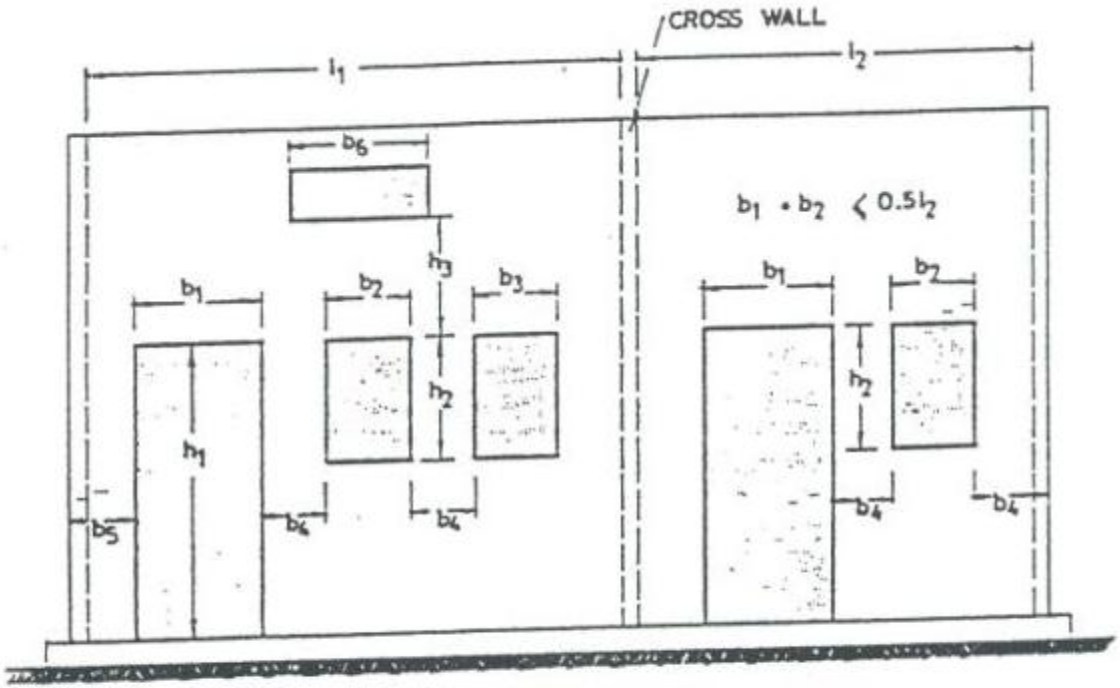


Figure 7.1-1 Cracking in Bearing Wall Building due to Bending and Shear



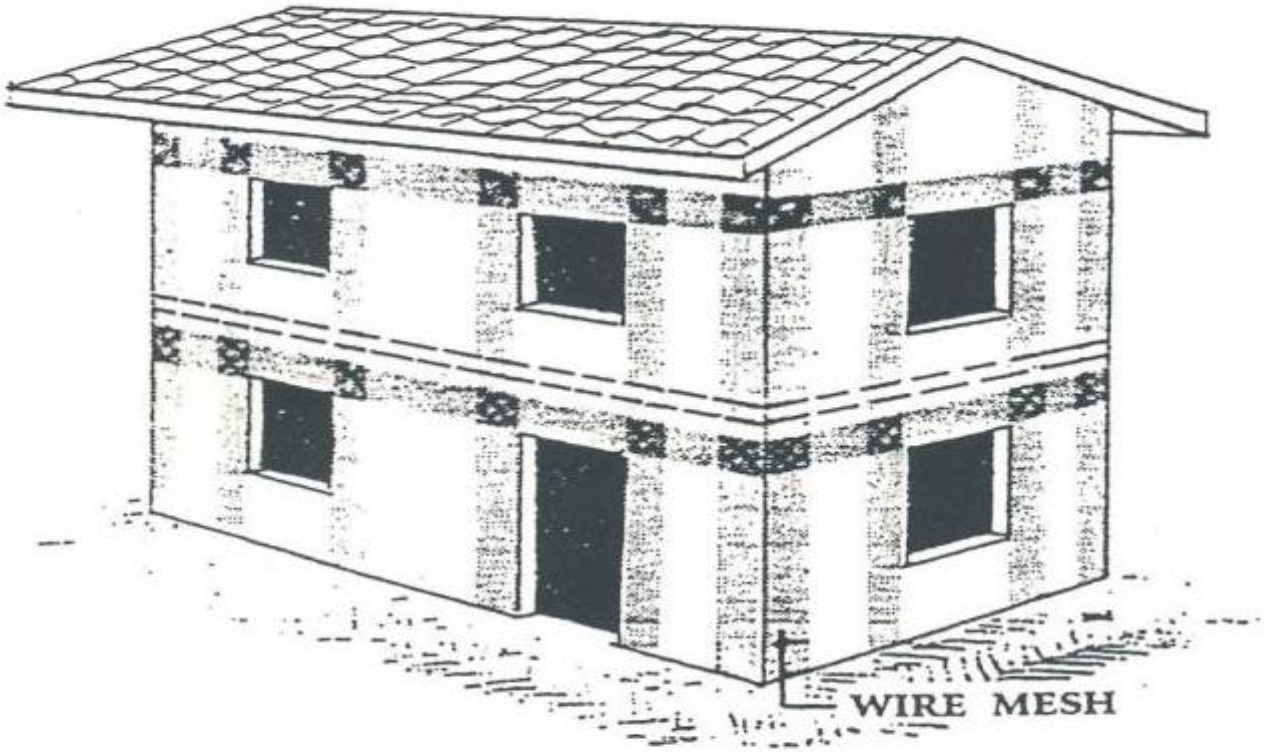
$b_1 + b_2 + b_3 < 0.5\ l_1$

$b_4 \geq 0.5\ h_2$

$b_5 \geq 0.25\ h_1$

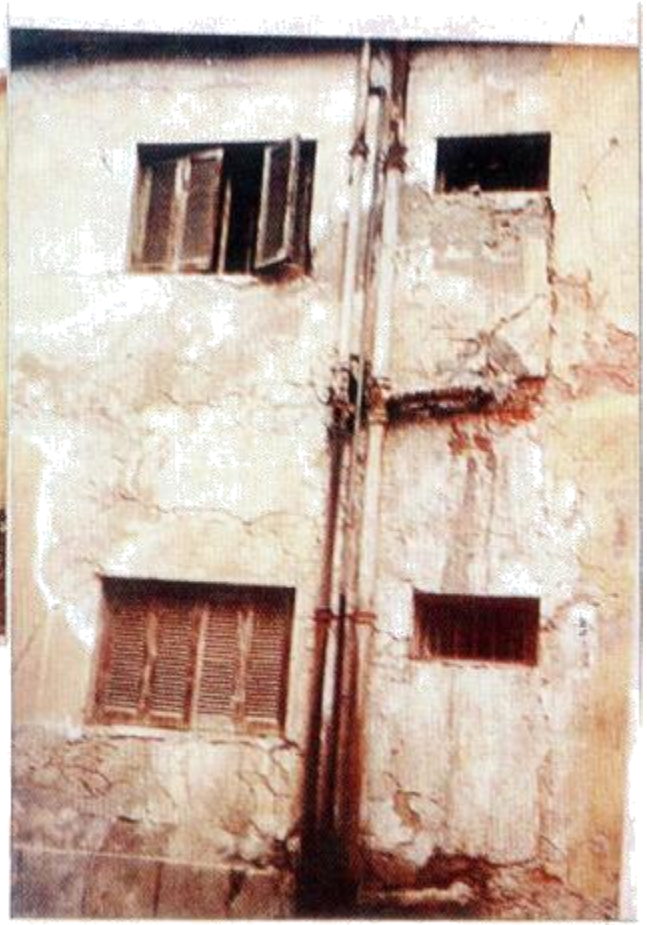
$h_3 \geq$ 60 cm or 0.5 (b_2 or b_6 whichever is more)

Figure 9.1-1 Recommendation regarding openings in bearing walls [1]

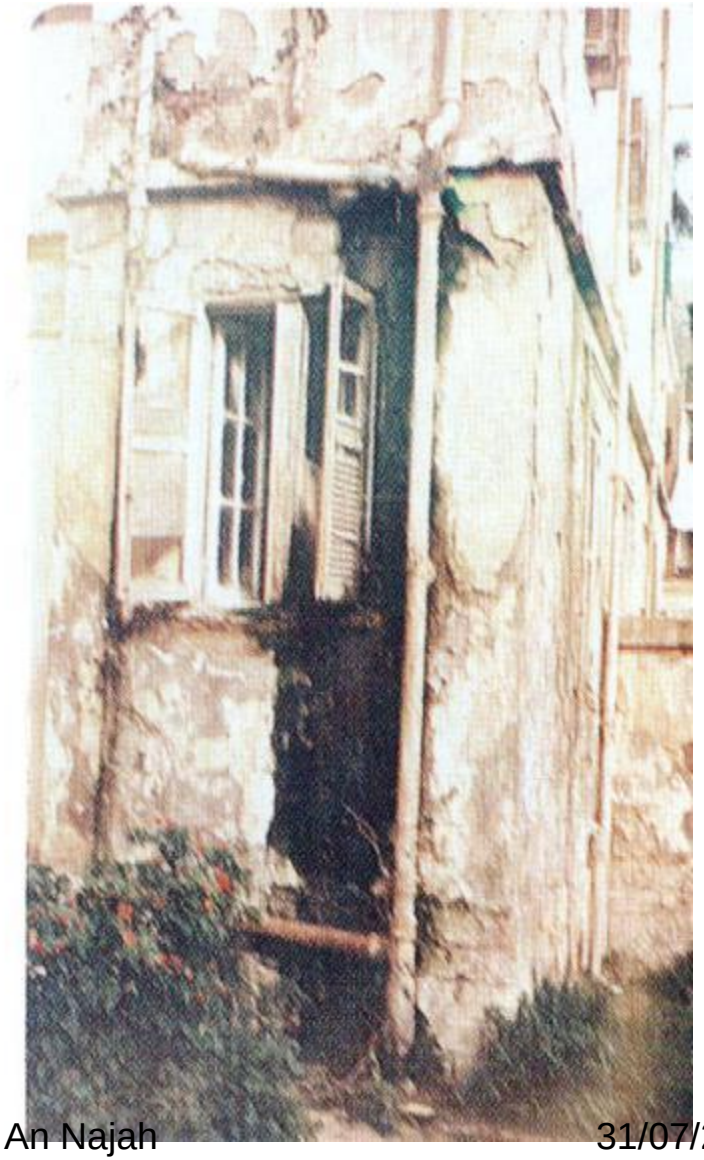


NOTE : WIDTH OF WIRE MESH ≥ 400 mm

Figure 9.1.21 Splint and bandage strengthening technique [1]



قصور في صيانة وحماية المنشآت

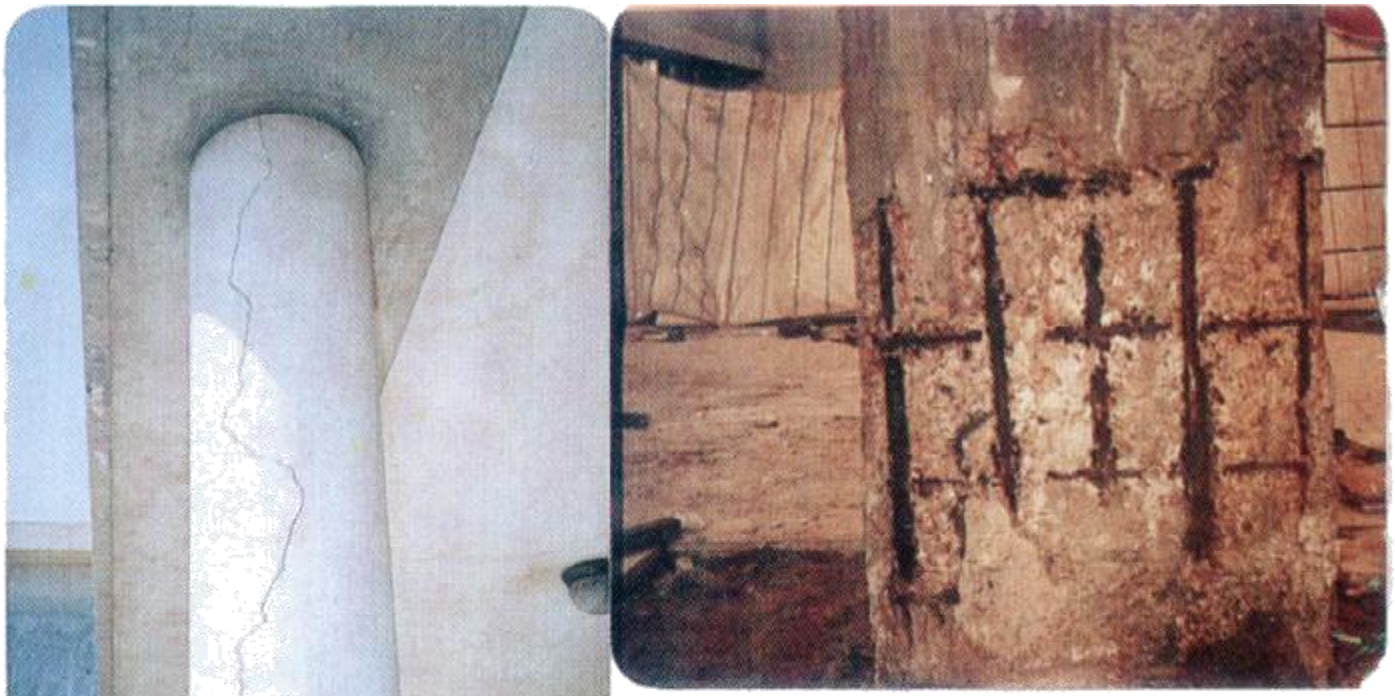


سقوط الغطاء الخرسانى نتيجة الصدأ

سقوط الغطاء الخرسانى وظهور

الصدأ فى الحديد الرئيسى والكانات

سقوط بلاطة سقف المصنع نتيجة الصدأ وتراكم المياه فوقها .



بقع الصدأ ذات اللون البنى

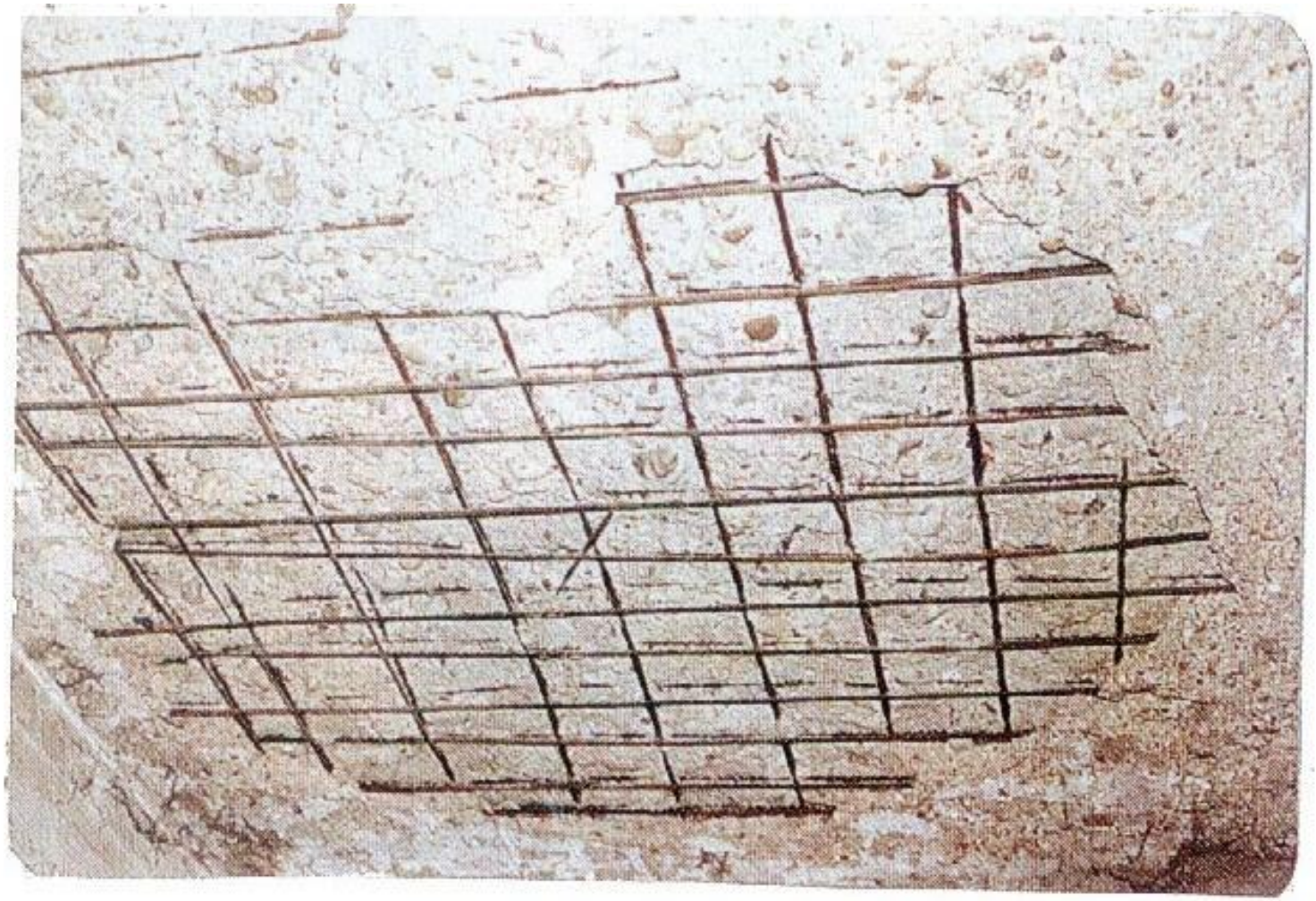
) شرخ رأسى (موازى لحديد التسليح) سببه الصدأ

سقوط الغطاء

شروخ صدأ الحديد

الخرسانى للبلاطة بسبب الصدأ

الطولية الموازية للتسليح السفلى للكمرة



انهيار وتهدم المباني نتيجة صدأ الحديد

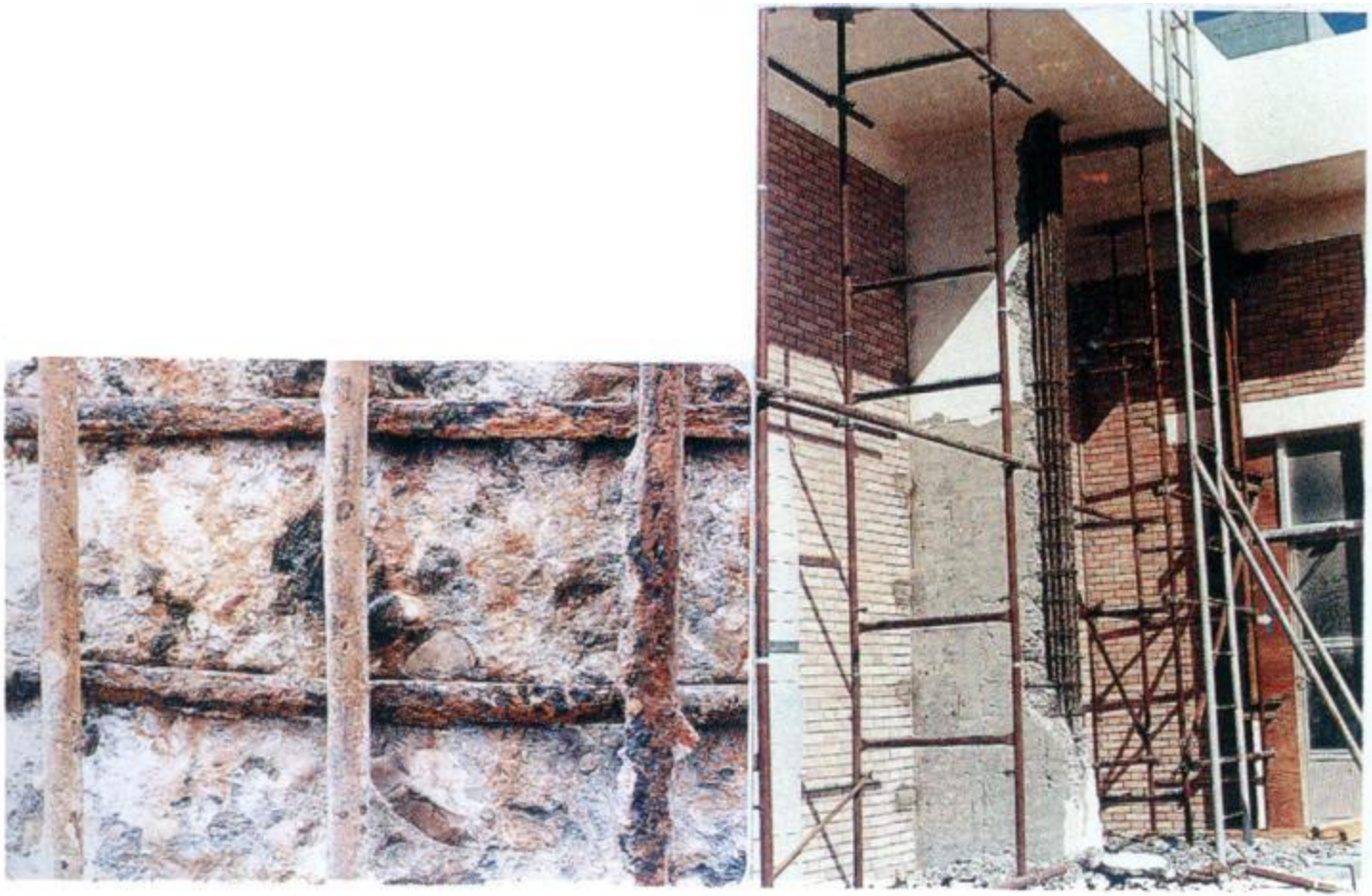
تأثير الأحماض

على الخرسانة السطحية

وصول تأثير

الأحماض إلى صلب التسليح

ما هو الحل للحماية من هذه المشاكل؟



إزالة الخرسانة بحيث تظهر أسياخ التسليح لإزالة الصدأ من عليها

إزالة الخرسانة بعمق كاف خلف أسياخ العامو

تنظيف صلب التسليح باستخدام الأجهزة الكهربائية

THANKS

زوروا:
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seiscen@najah.edu

شكراً لحسن اصغائكم