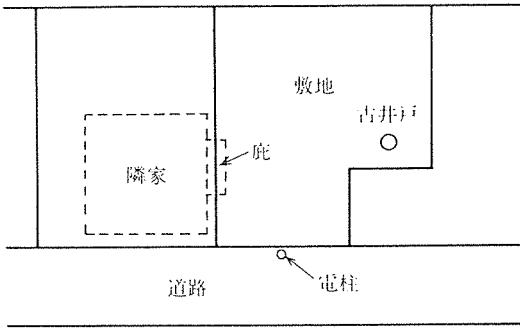
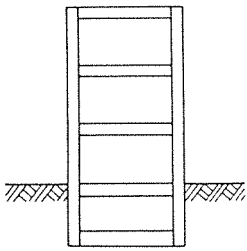
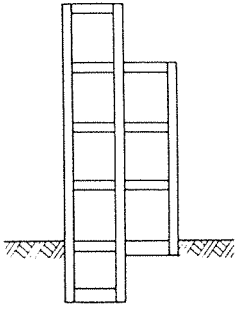
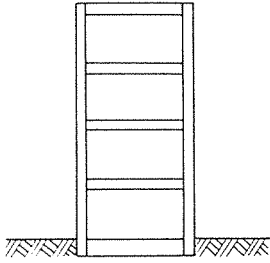


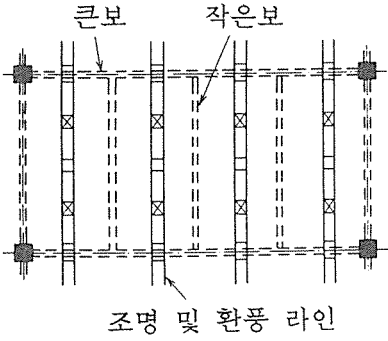
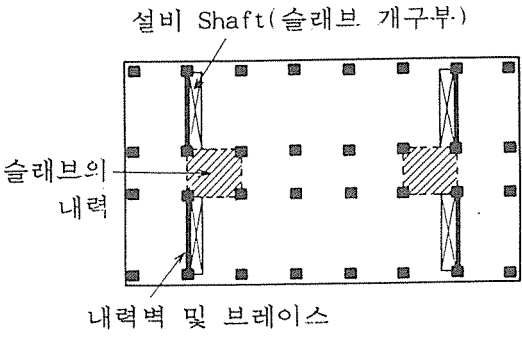
## 부록. 구조물의 하자발생 요인 및 대책

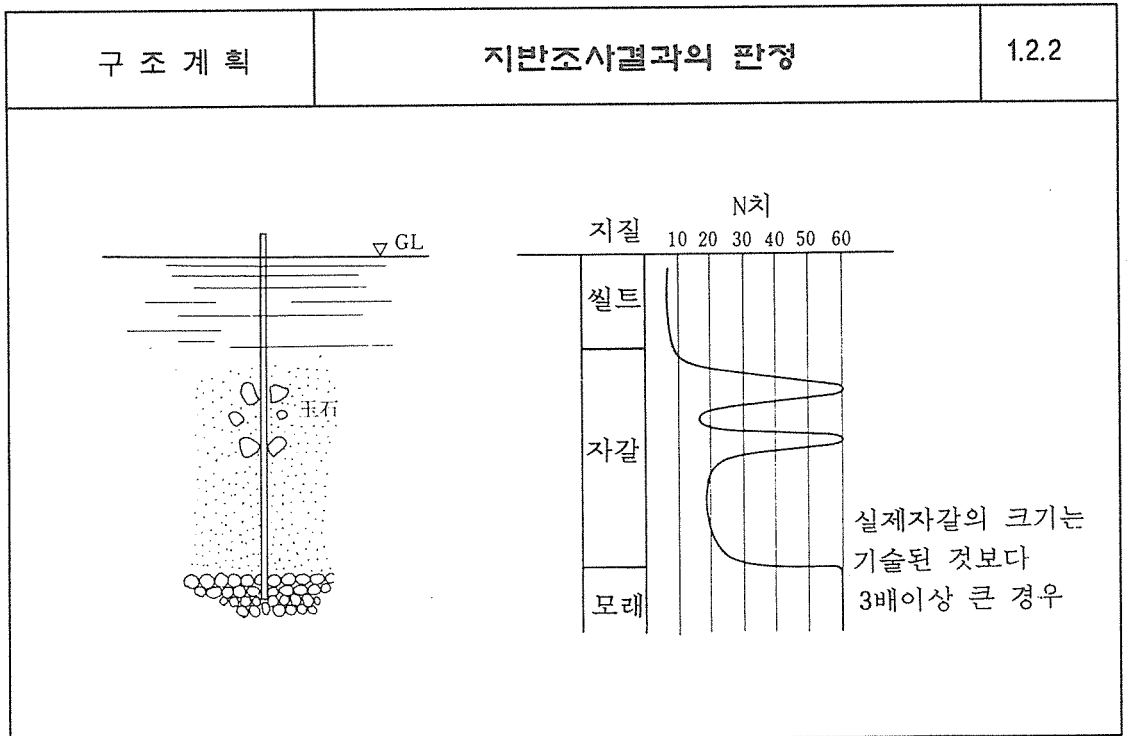
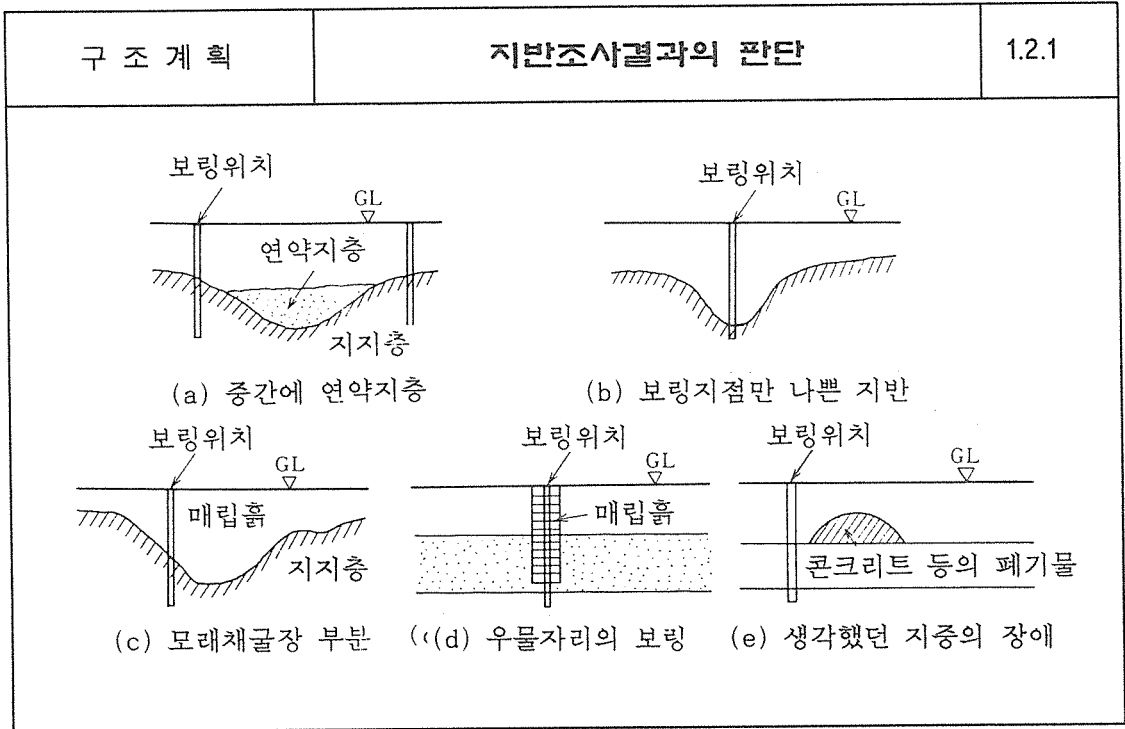



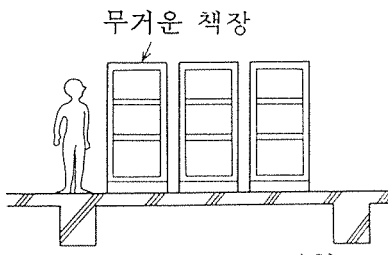
전 체 계 획	현 지 조 사	1.1.1
 <p>The diagram illustrates a site investigation layout. It shows a rectangular plot divided into sections. On the left, a dashed-line rectangle is labeled '隣家' (Neighboring house). To its right is the '敷地' (Plot) area, which contains a circle labeled '古井戸' (Old well). Below the plot is a horizontal line labeled '道路' (Road), with a small circle labeled '電柱' (Electric pole) positioned on it. A vertical line labeled '庇' (Eave) is shown between the '隣家' and the '敷地'.</p>		

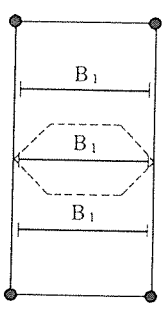
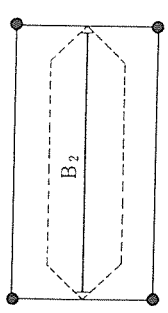
전 체 계 획	하중과 안전을	1.1.2
<p>설계순서는 다음과 같다.</p> <div data-bbox="281 1417 1002 1503" style="border: 1px solid black; padding: 5px; text-align: center;"> <p>① 荷重設定 → ② 応力算定 → ③ 断面設計</p> </div>		

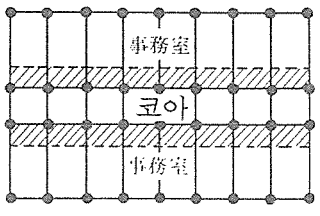
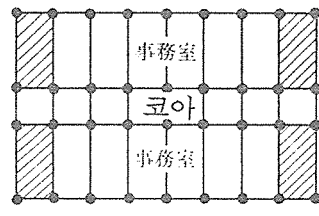
전 체 계 획	지하층의 비율	1.1.3
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>(a) 전면지하</p> </div> <div style="text-align: center;">  <p>(b) 부분지하</p> </div> <div style="text-align: center;">  <p>(c) 지하가 없는 경우</p> </div> </div>		

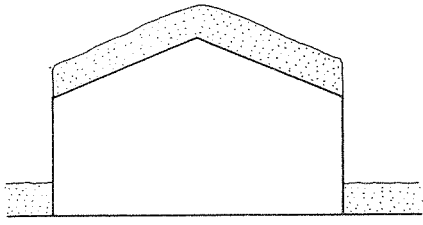
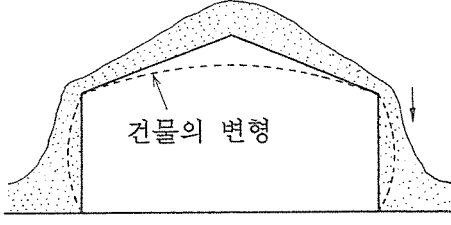
전 체 계 획	건축, 설비계획과 정리	1.1.4
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>(a) 작은보 배치와 조명, 환풍 라인</p> </div> <div style="text-align: center;">  <p>(b) 설비 샤프트와 슬래브 개구부</p> </div> </div>		



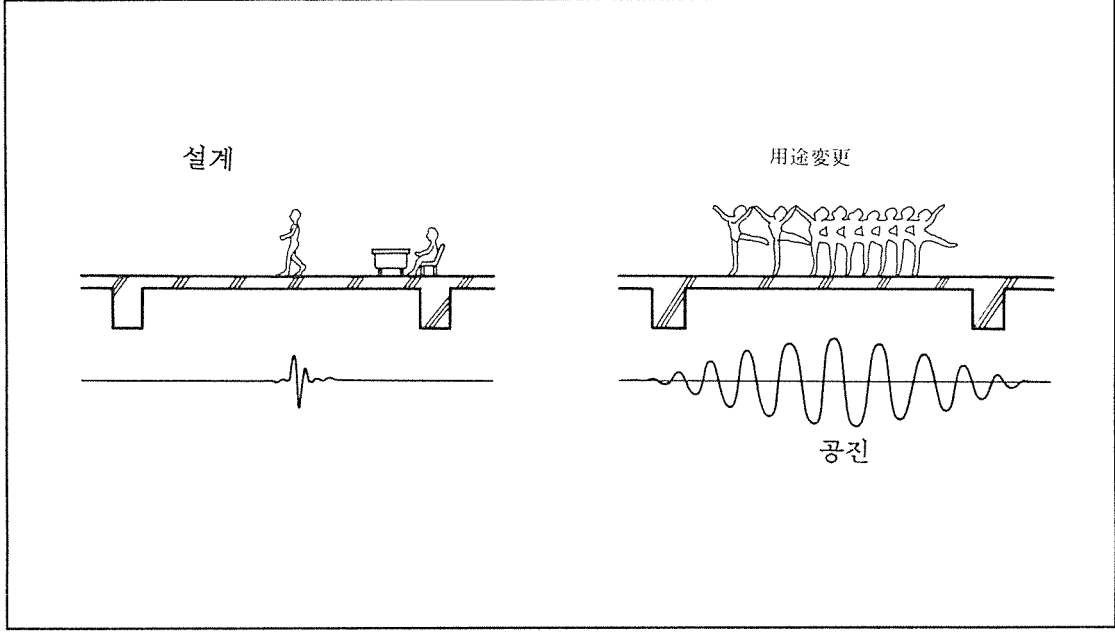
전 체 계 획	적재 하중	1.2.3
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>보통 사무실</p> </div> <div style="text-align: center;">  <p>무거운 책장</p> <p>예상되는 하중상황</p> </div> </div> <div style="text-align: center; margin-top: 20px;"> <p>설계하중 →</p> <p>↑</p> <p>하중의 크기가 변경되지 않도록 고려</p> </div>		

전 체 계 획	작은보의 적재하중	1.2.4
<div style="display: flex; justify-content: space-around; align-items: center; margin-bottom: 20px;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div> <div style="display: flex; justify-content: space-around;"> <p>(a) 슬래브에 가까운 작은보</p> <p>(b) 큰보에 가까운 작은보</p> </div>		

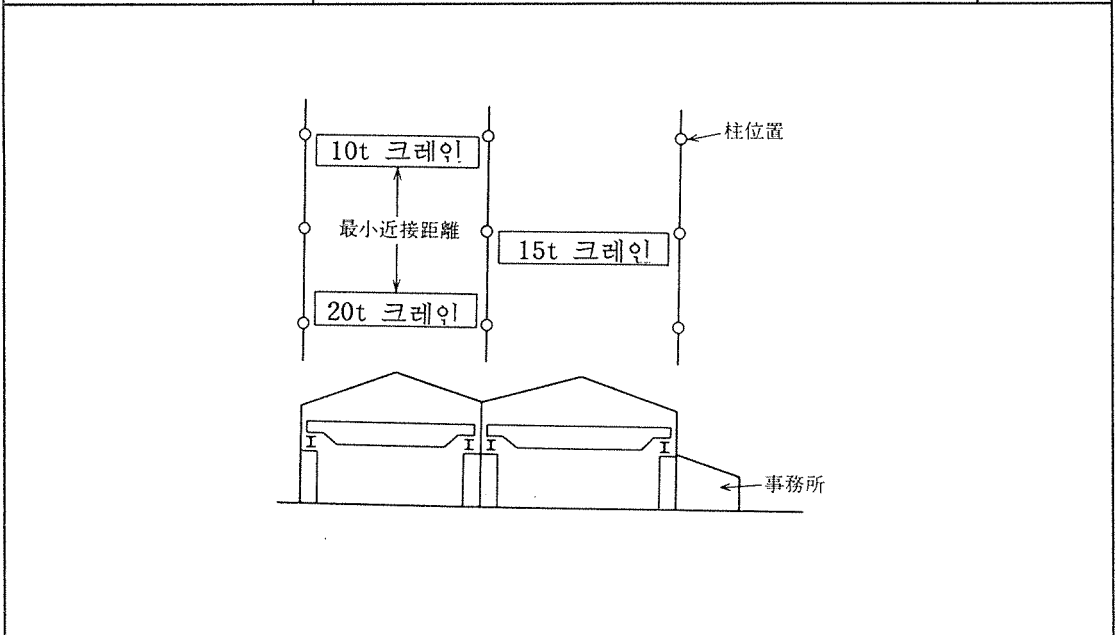
구조 계획	사무실의 적재하중	1.2.5
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>(a)</p> </div> <div style="text-align: center;">  <p>(b)</p> </div> </div>		

구조 계획	설계용 하중의 설정	1.2.6
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>(a) 정적하향하중</p> </div> <div style="text-align: center;">  <p>(b) 沈降圧</p> </div> </div>		

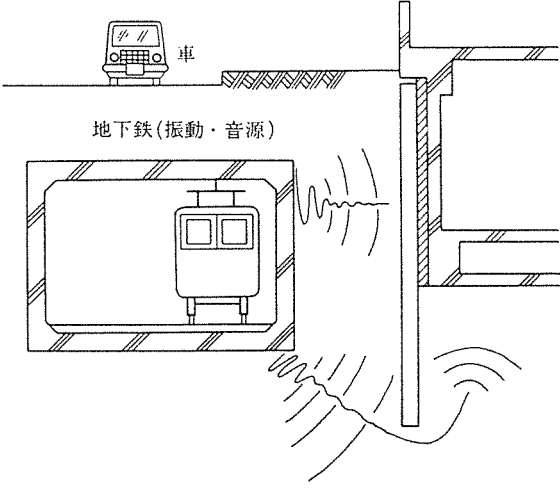
구조 계획	슬래브, 보의 진동하중	1.2.7
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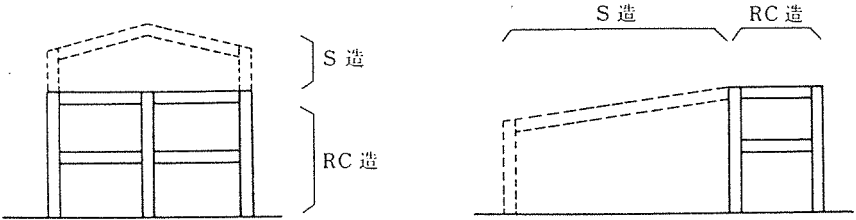


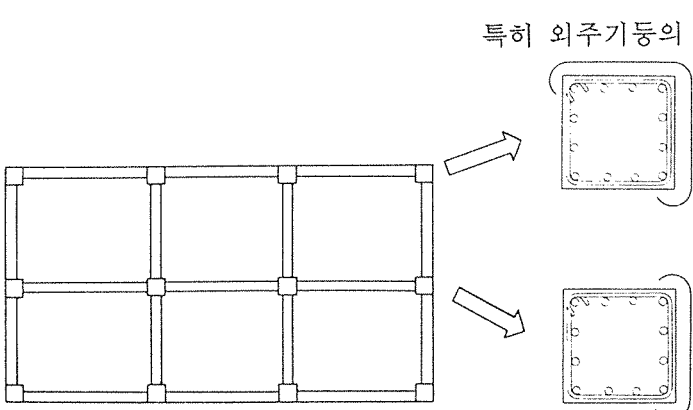
구조 계획	크레인의 조건	1.2.8
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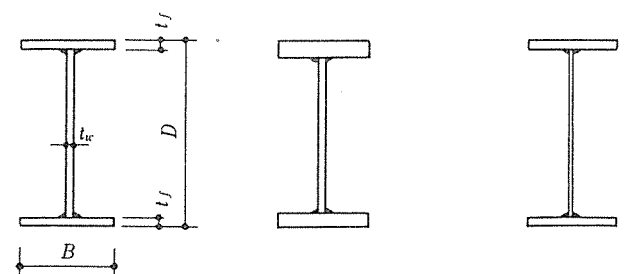




구조 계획	지반주변의 진동에 의한 영향	1.2.9
		

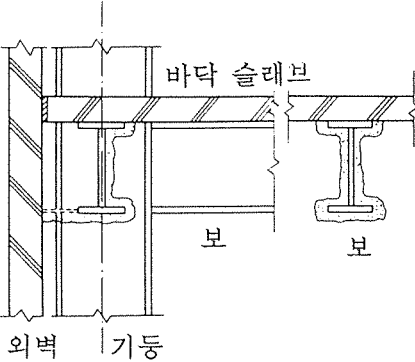
구조 계획	종별이 다른 구조와의 연결	1.2.10
		

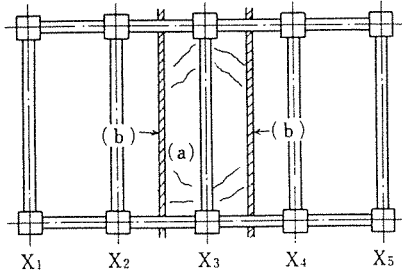
재료의 선정	기둥주근의 가스압접부위 단수	2.1.1
<p style="text-align: center;">특히 외주기둥의 외주부</p> 		

재료의 선정	용접 H형 부재의 관두깨비	2.1.2
 <p style="text-align: center;">(a) 標準      (b) <math>t_f &gt; t_w</math>      (c) <math>D/t_w</math> 大</p>		

구조종별과 특성	구조종별의 선정	2.2.1
$PC \leftrightarrow PRC \leftrightarrow RC \leftrightarrow sRC \leftrightarrow SRC \leftrightarrow SrC \leftrightarrow SC \leftrightarrow S$		
	프리스트레스트 콘크리트 구조 철근콘크리트 구조 철골철근콘크리트 구조 철골콘크리트 구조 철골 구조	
[鉄筋量 R] [鉄骨量 S]	少 $\leftrightarrow$ 中 $\leftrightarrow$ 多 $\leftrightarrow$ 多 $\leftrightarrow$ 中 $\leftrightarrow$ 少 $\leftrightarrow$ 0 $\leftrightarrow$ 0 0 $\leftrightarrow$ 0 $\leftrightarrow$ 0 $\leftrightarrow$ 少 $\leftrightarrow$ 中 $\leftrightarrow$ 多 $\leftrightarrow$ 多 $\leftrightarrow$ 多	

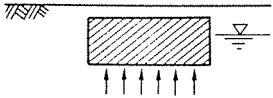
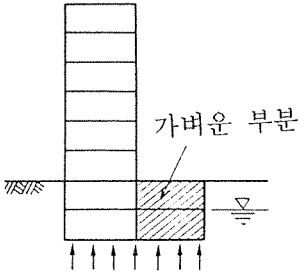
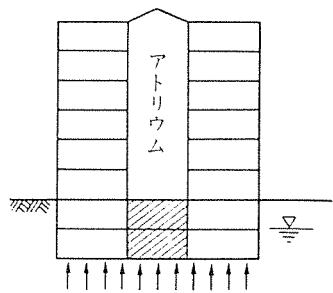
구조종별과 특성	정방형은 45° 방향이 약하다	2.2.2												
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>(a) 정방형 플랜</p> </div> <div style="text-align: center;"> <p>(b) 박스기둥</p> </div> </div>														
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 20%;"></th> <th style="width: 40%;">0, 90° 方向</th> <th style="width: 40%;">45° 方向</th> </tr> </thead> <tbody> <tr> <td>기둥의 전단력</td> <td style="text-align: center;"><math>\frac{1}{4} Q</math></td> <td style="text-align: center;"><math>\frac{1}{4} Q</math></td> </tr> <tr> <td>기둥의 부가축력</td> <td style="text-align: center;"><math>M/2l</math></td> <td style="text-align: center;"><math>M/\sqrt{2}l</math></td> </tr> </tbody> </table>				0, 90° 方向	45° 方向	기둥의 전단력	$\frac{1}{4} Q$	$\frac{1}{4} Q$	기둥의 부가축력	$M/2l$	$M/\sqrt{2}l$			
	0, 90° 方向	45° 方向												
기둥의 전단력	$\frac{1}{4} Q$	$\frac{1}{4} Q$												
기둥의 부가축력	$M/2l$	$M/\sqrt{2}l$												
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 20%;"></th> <th style="width: 40%;">0, 90° 方向</th> <th style="width: 40%;">45° 方向</th> </tr> </thead> <tbody> <tr> <td>단면 2차 모멘트</td> <td style="text-align: center;"><math>I_0</math></td> <td style="text-align: center;"><math>I_0</math></td> </tr> <tr> <td>断面係数 (弹性)</td> <td style="text-align: center;"><math>Z_{e0}</math></td> <td style="text-align: center;"><math>\frac{1}{\sqrt{2}} Z_{e0}</math></td> </tr> <tr> <td style="text-align: center;">// (全塑性)</td> <td style="text-align: center;"><math>Z_{p0}</math></td> <td style="text-align: center;"><math>\approx Z_{p0}</math></td> </tr> </tbody> </table>				0, 90° 方向	45° 方向	단면 2차 모멘트	$I_0$	$I_0$	断面係数 (弹性)	$Z_{e0}$	$\frac{1}{\sqrt{2}} Z_{e0}$	// (全塑性)	$Z_{p0}$	$\approx Z_{p0}$
	0, 90° 方向	45° 方向												
단면 2차 모멘트	$I_0$	$I_0$												
断面係数 (弹性)	$Z_{e0}$	$\frac{1}{\sqrt{2}} Z_{e0}$												
// (全塑性)	$Z_{p0}$	$\approx Z_{p0}$												

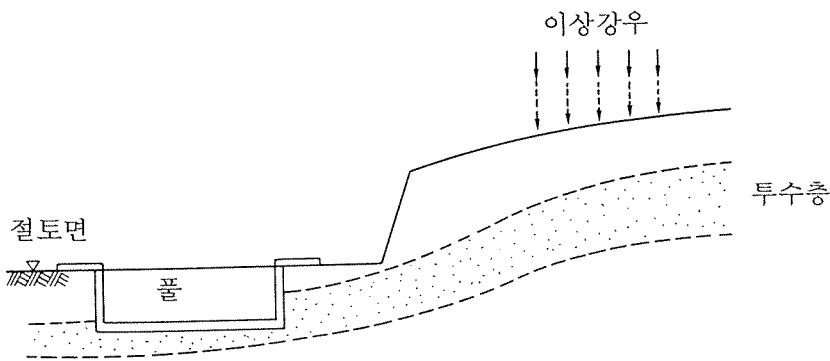
구조종별과 특성	내외피복과 방청도장	2.2.3
		

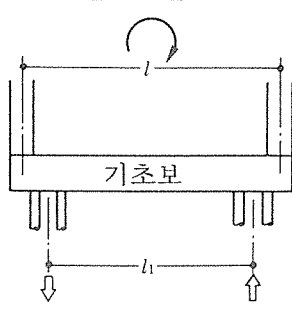
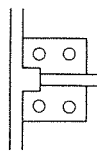
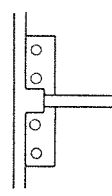
구조종별과 특성	PC구조의 프리스트레싱 도입방법	2.2.4
 <p data-bbox="692 1421 1042 1558">         [方法 1]  <math>X_3 \rightarrow X_2 \rightarrow X_4 \rightarrow X_1 \rightarrow X_5</math>의 반복          [方法 2]  <math>X_1 \rightarrow X_3 \rightarrow X_5 \rightarrow X_2 \rightarrow X_4</math>의 반복       </p>		

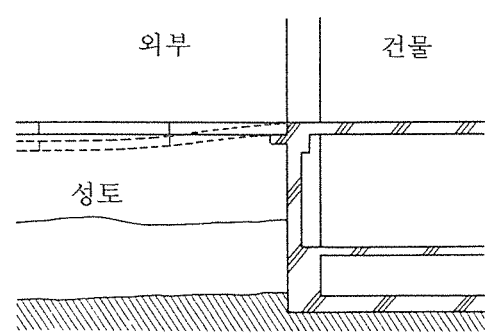
기 초 구 조	기 초형식의 선정	2.3.1
<div style="text-align: center;"> <p>기존건물</p> <p>계획건물</p> <p>표층</p> <p>직접기초</p> <p>말뚝기초</p> <p>사질</p> </div>		

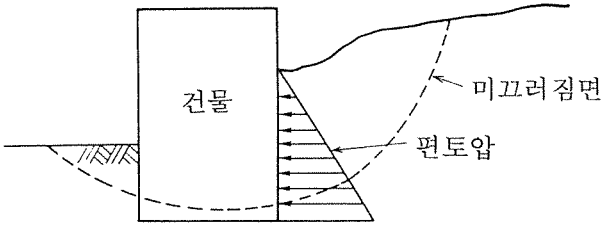
기 초 구 조	다른 종류의 기초를 혼용	2.3.2
<div style="text-align: center;"> <p>摩擦杭</p> <p>支持杭</p> <p>(a)</p> <p>中間層</p> <p>支持杭</p> <p>(b)</p> <p>直接基礎</p> <p>支持杭</p> <p>(c)</p> <p>地盤改良</p> <p>(d)</p> </div>		

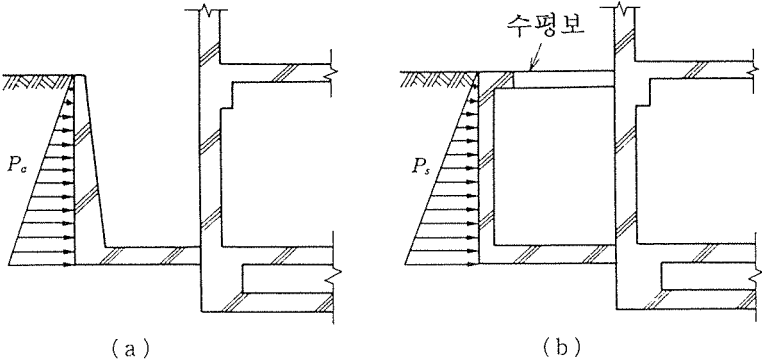
기 초 구 조	지하수에 의한 부력	2.3.3
<div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  <p>(a) 지하구조물</p> </div> <div style="text-align: center;">  <p>(b) 주변지하실</p> </div> <div style="text-align: center;">  <p>(c) 취발의 하부</p> </div> </div>		

기 초 구 조	이상강우에 의한 지하수의 상승	2.3.4
		

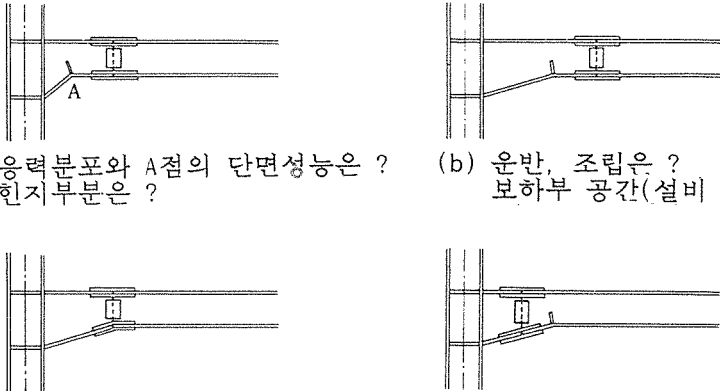
기 초 구 조	편 심 기 초	2.3.5
<div style="text-align: center;"> <p>전도모멘트</p>  <p>(a)</p>  <p>(b)</p>  <p>(c)</p> </div>		

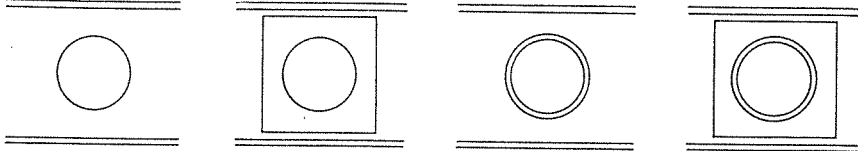
기 초 구 조	매립토, 성토의 침하에 대한 대책	2.3.6
<div style="text-align: center;">  </div>		

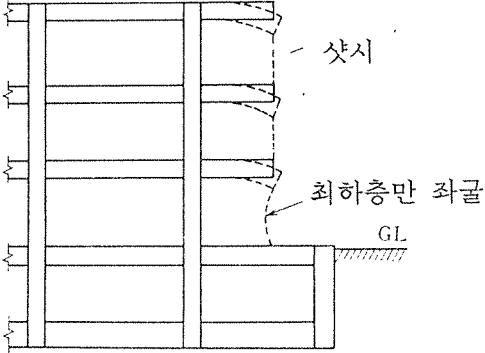
지 하 구 조	경사지 건물	2.4.1
 <p>The diagram shows a rectangular building labeled '건물' (Building) situated on a sloping ground. To the left of the building, a dashed line represents a failure surface, with a hatched area indicating soil. To the right, another dashed line represents a failure surface, with a hatched area indicating soil. Horizontal arrows pointing towards the building represent soil pressure. Labels include '미끄러짐면' (Sliding surface) pointing to the right-hand failure surface and '편토압' (Soil pressure) pointing to the horizontal arrows.</p>		

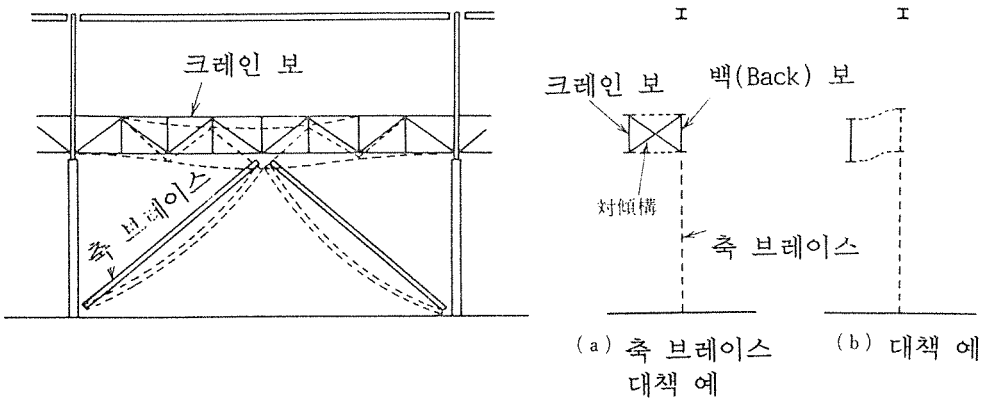
지 하 구 조	드라이 에리어	2.4.2
 <p>The diagram shows two cross-sections of a structure, labeled (a) and (b). In (a), a trapezoidal soil mass is shown on the left, with horizontal arrows representing soil pressure labeled <math>P_c</math>. In (b), a similar soil mass is shown on the left, with horizontal arrows representing soil pressure labeled <math>P_s</math>. A horizontal line labeled '수평보' (Water table) is shown above the structure in (b). The structure consists of a vertical wall and a horizontal base.</p>		



골 조 구 조	철골보의 단부 형상과 단수위치	2.5.1
		
(a) 응력분포와 A점의 단면성능은 ? 힌지부분은 ?		(b) 운반, 조립은 ? 보하부 공간(설비 등)은 ?
(c) 스플라이스 플레이트 절곡부의 힘의 평형은 ? 밀착성은 ?		(d) 보 중앙의 가공성은 ? 힌지부분은 ?

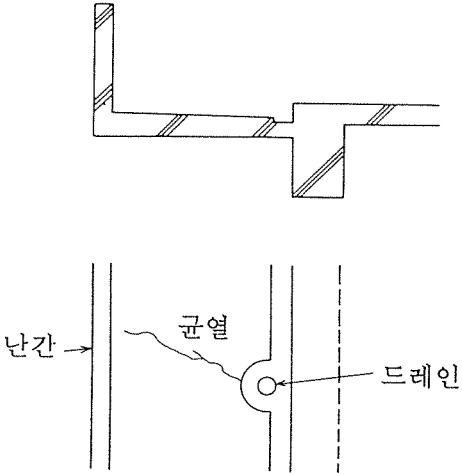
골 조 구 조	철골보의 관통부위 보강	2.5.2
		
(a) 웨브를 두겹게 함		(b) 강판 보강
(c) 강관 보강		(d) 강관과 강판 보강

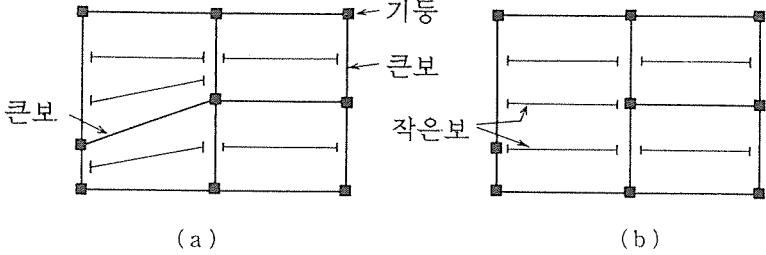
골 조 구조	예상외의 변형 (펜틸레버 보의 크리프)	2.5.3
		

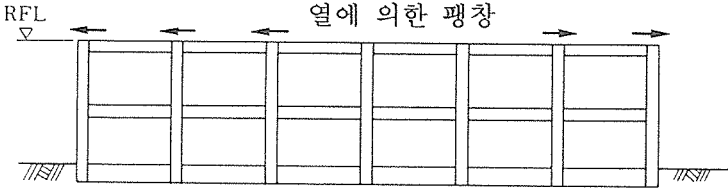
골 조 구조	예상외의 변형 ( 압축변형 )	2.5.4
		

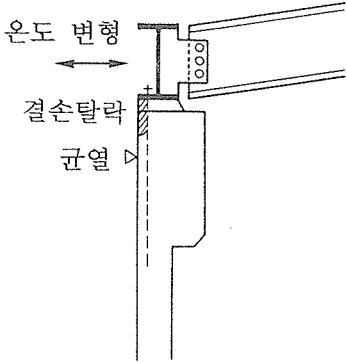
슬래브 구조	RC 조 캔틸레버보의 앵커	2.6.1

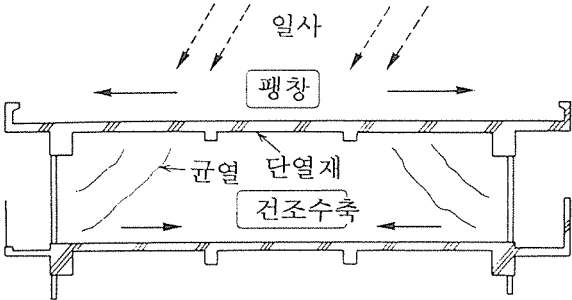
슬래브 구조	RC조 작은보의 강성부족	2.6.2

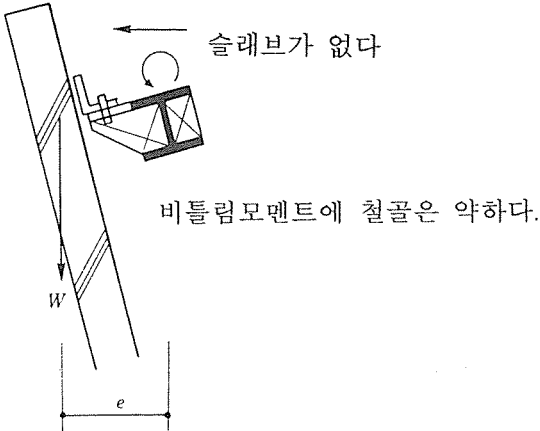
슬래브 구조	발코니 슬래브의 균열	2.6.3
 <p>The diagram illustrates the structural details and cracking of a balcony slab. The top part is a cross-section showing a vertical wall on the left, a horizontal slab, and a drainage channel on the right. The bottom part is a plan view showing a vertical wall (labeled '난간') on the left, a drainage hole (labeled '드레인') on the right, and a crack (labeled '균열') that has formed in the slab between the wall and the drain.</p>		

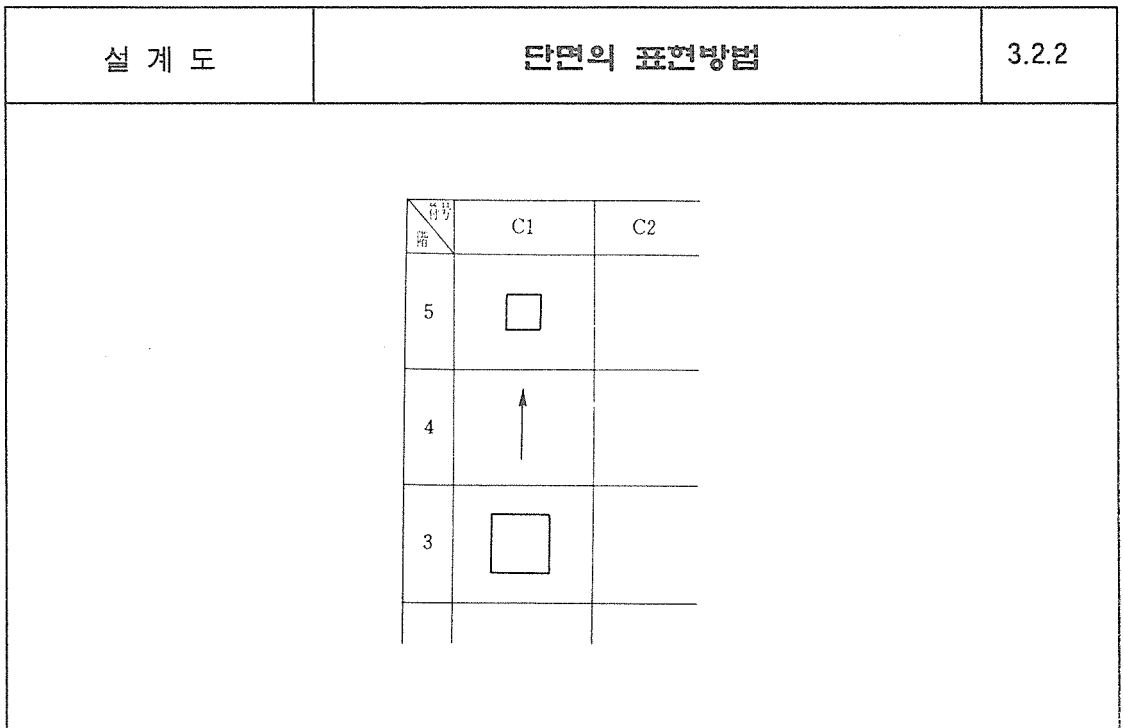
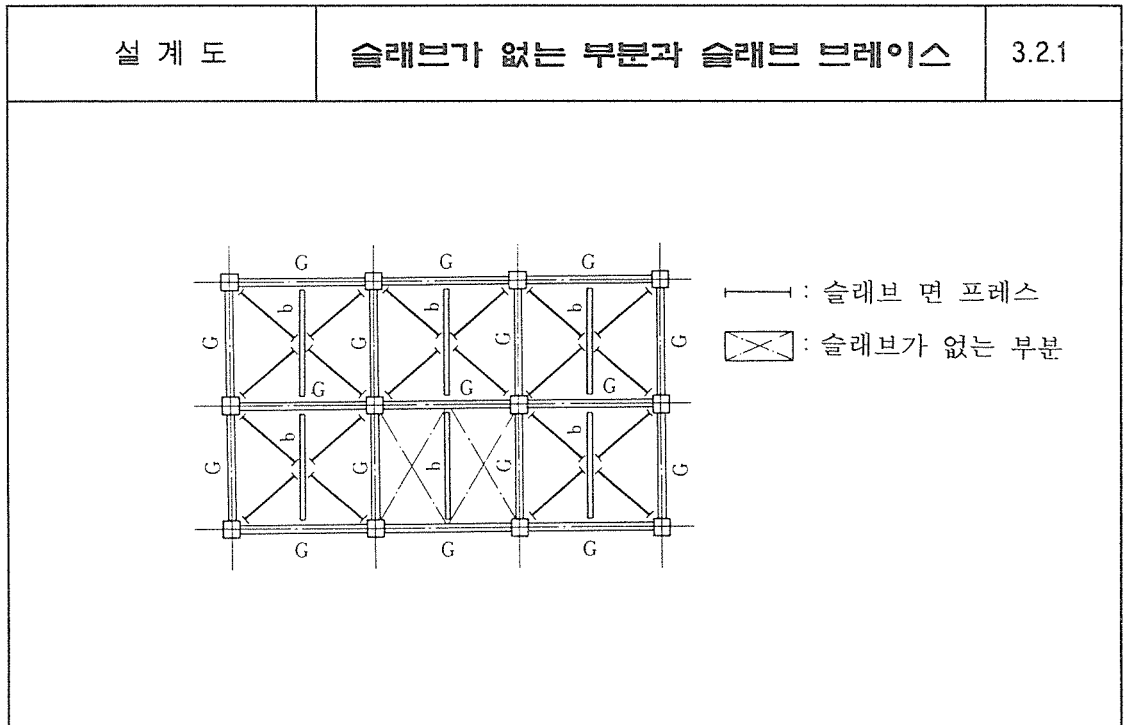
슬래브 구조	슬래브 구조는 명쾌하게	2.6.4
 <p>The diagrams show two slab structures, (a) and (b). Diagram (a) is a rectangular slab with four supports (labeled '기둥') at the corners. It has three horizontal spans, with the middle one being the largest (labeled '큰보') and the two side ones being smaller (labeled '작은보'). Diagram (b) is a similar slab but with a different span arrangement, also showing '기둥', '큰보', and '작은보' labels.</p>		

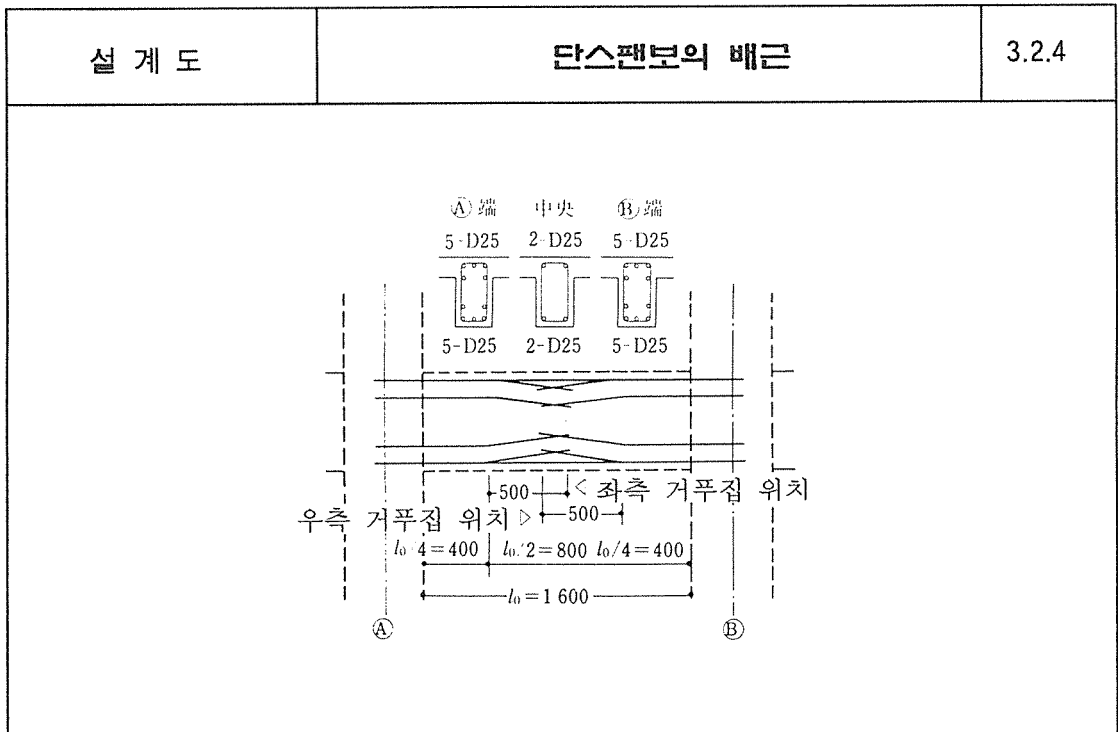
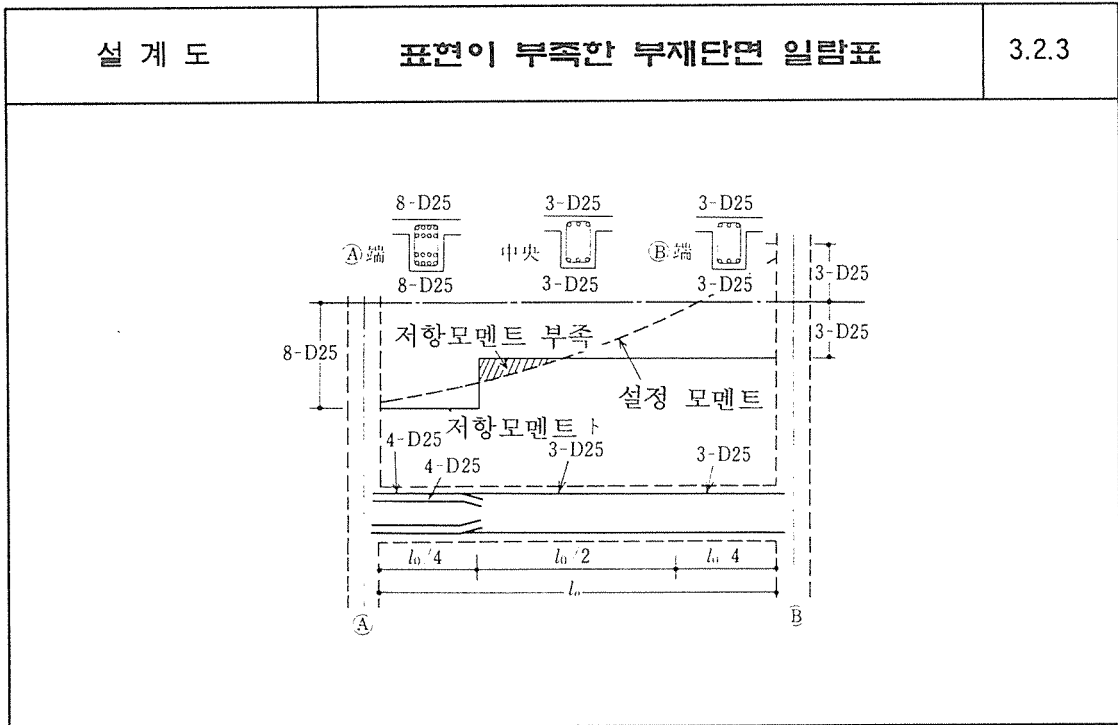
<p>옥 상 구 조</p>	<p>옥상 슬래브의 열팽창</p>	<p>2.7.1</p>
		

<p>옥 상 구 조</p>	<p>철골조 앵커볼트부의 파손</p>	<p>2.7.2</p>
		

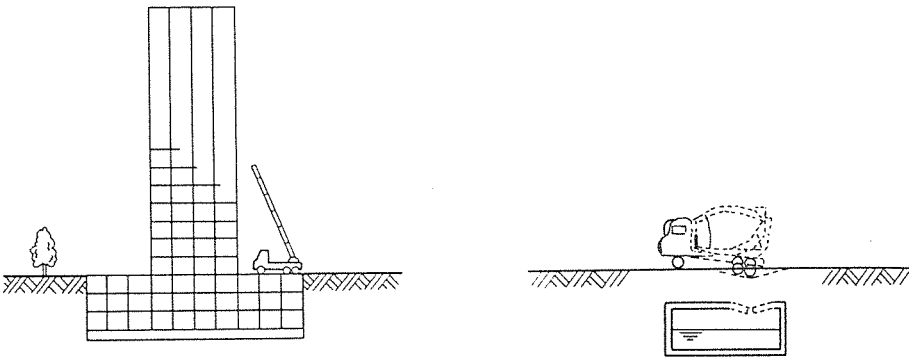
내외벽체 구조	최상층 RC조 벽의 균열	2.8.1
 <p>The diagram illustrates the cross-section of a top RC wall. It shows solar radiation ('일사') hitting the exterior surface, causing expansion ('팽창'). The wall contains insulation ('단열재') and is subjected to drying shrinkage ('건조수축'). A crack ('균열') is shown forming in the concrete due to these effects.</p>		

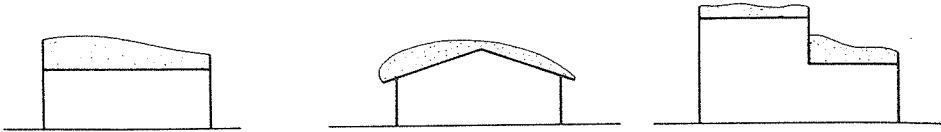
내외벽체 구조	무거운 외벽에 대한 지지	2.8.2
 <p>The diagram shows a heavy exterior wall without a slab ('슬래브가 없다'). The wall is cantilevered, with a weight <math>W</math> acting at an eccentricity <math>e</math> from the vertical axis. A note states: '비틀림모멘트에 철골은 약하다.' (steel is weak against torsion moment).</p>		

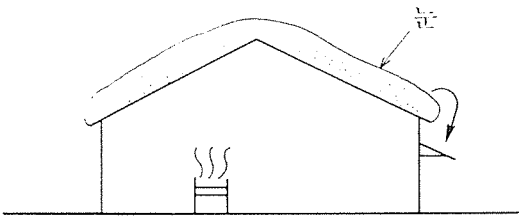


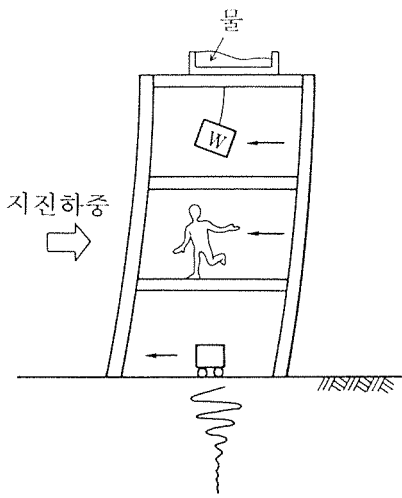


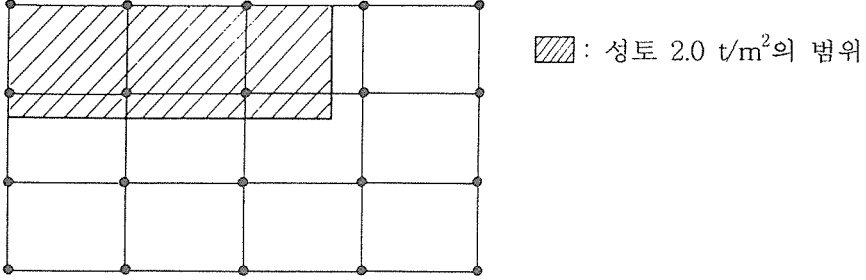


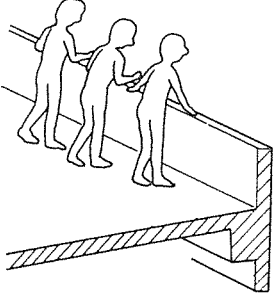
하중, 외력의 설정	소방차 등의 하중	4.1.1
		

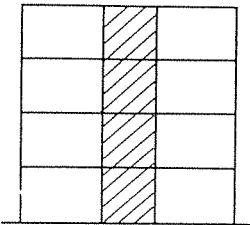
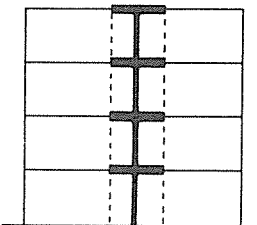
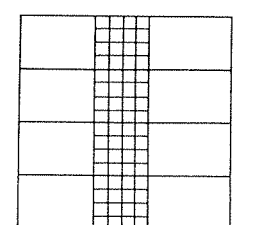
하중, 외력의 설정	적설하중의 편심작용	4.1.2
 <p data-bbox="230 1544 477 1609">(a) 파라펫의 높이가 다른 경우</p> <p data-bbox="600 1536 847 1569">(b) 경사지붕의 경우</p> <p data-bbox="920 1536 1177 1569">(c) 높이가 다른 경우</p>		

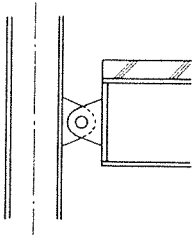
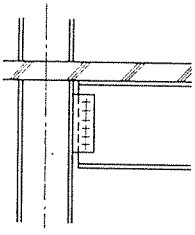
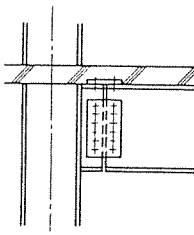
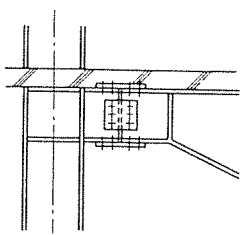
하중, 외력의 설정	낙 하중	4.1.3
		

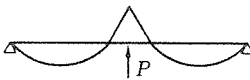
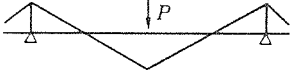
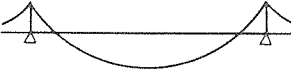



하중, 외력의 설정	지진시의 적재하중	4.1.4
		

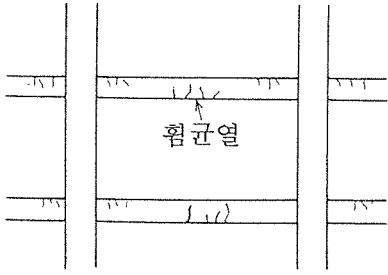
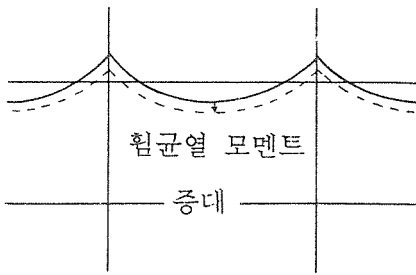
하중, 외력의 설정	특수한 하중조건	4.1.5
<div style="display: flex; align-items: center; justify-content: center;">  </div>		

하중, 외력의 설정	밀집 하중	4.1.6
<div style="display: flex; align-items: center; justify-content: center;">  </div>		

구조물의 모델화	정밀한 해석과 정확한 해석	4.2.1
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>내진벽 가구</p> </div> <div style="text-align: center;">  <p>(a) 선제의 모델 (略解)</p> </div> <div style="text-align: center;">  <p>(b) FEM 모델 (精解)</p> </div> </div>		

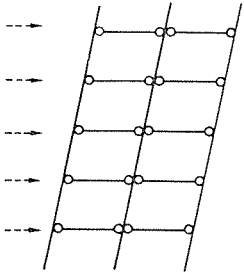
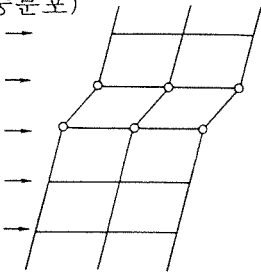
구조물의 모델화	핀접합의 상세	4.2.2
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>(a) 핀</p> </div> <div style="text-align: center;">  <p>(b) 웨브의 접합 (회전시 슬래브 균열)</p> </div> <div style="text-align: center;">  <p>(c) 웨브 + 플랜지 접합 (슬래브면의 변형이 작다, 반강접)</p> </div> <div style="text-align: center;">  <p>(d) 웨브 + 플랜지 접합 (춤이작다, 강접)</p> </div> </div>		

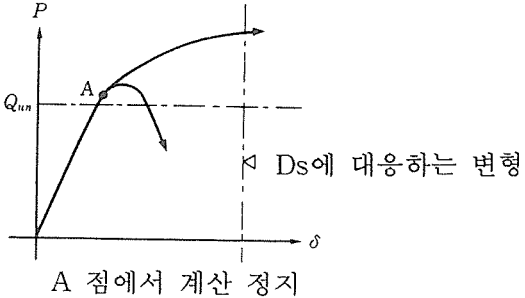
구조물의 모델화	시공방법에 따른 응력의 변화	4.2.3
<p>(a) 시공하중시 응력 (데크플레이트 응력)</p> <p>(b) 서포트 제거시 부가응력 (슬래브 응력)</p> <p>(c) 마감 적재하중시 부가응력 (슬래브 응력)</p>	<p>[중간 서포트 유]</p>   	<p>[중간 서포트 무]</p>   

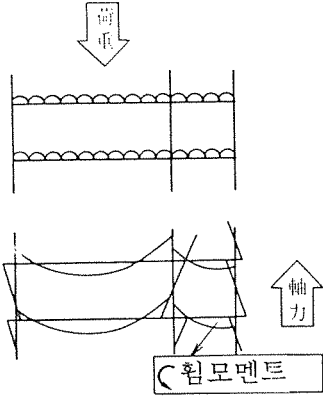
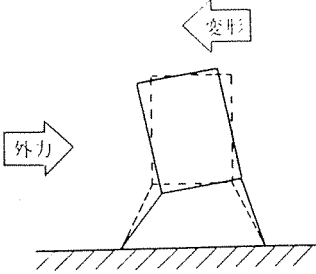
구조물의 모델화	고정도의 변화	4.2.4
	<p>⇔</p> 	

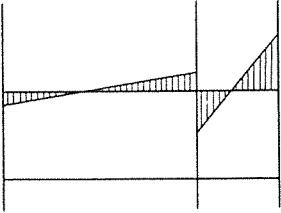
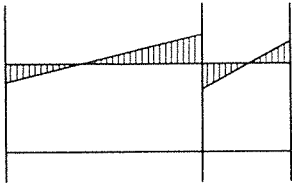
응력해석과 내력산정	해석방법에 따라 변하는 보유수평내력	4.3.1
<div style="text-align: center;"> </div> <p style="text-align: center;"> <math>\delta_1</math> : 초기강성에 의한 설계시변형  <math>\delta_2</math> : 균열을 고려한 설계시변형 </p>		

응력해석과 내력산정	보유수평내력 계산의 문제점	4.3.2
<div style="display: flex; align-items: center;"> <div style="flex: 1;"> </div> <div style="flex: 2; padding-left: 20px;"> <p> <math>P-\delta</math> 효과를 무시할 경우 <math>i</math> 층의 전단력  <math>P-\delta</math> 효과를 고려할 경우 <math>i</math> 층의 전단력            부가전단력을 <math>\Delta Qi</math> 로 취하면  <math>Qi = Qi + \Delta Qi</math>  <math>\Delta Qi = ( P_{i-1} / H_{i-1} ) \delta_{i-1} - ( P_i / H_i ) \delta_i</math> </p> <math display="block">\Delta Qi = \frac{P_{i-1}}{H_{i-1}} \delta_{i-1} - \frac{P_i}{H_i} \delta_i</math> </div> </div>		

응력해석과 내력산정	RC조 골조의 강성	4.3.3
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>(하중분포 불명)</p>  <p>(a) 절점모멘트 분배법</p> </div> <div style="text-align: center;"> <p>(하중분포)</p>  <p>(b) 하중증분법</p> </div> </div>		

응력해석과 내력산정	P - $\delta$ 의 영향	4.3.4
<div style="text-align: center;">  <p>A 점에서 계산 정지</p> <p>Ds에 대응하는 변형</p> </div>		

해석결과의 검토	응력도, 변형도의 확인	4.4.1
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>(a)</p> </div> <div style="text-align: center;">  <p>(b)</p> </div> </div>		

해석결과의 검토	모델화와 해석결과	4.4.2
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>(a) 단 스패보 : 탄성</p> </div> <div style="text-align: center;">  <p>(b) 단 스패보 : 강성저하</p> </div> </div>		



안전성 검토	철근량의 연속성	4.5.1
<div style="text-align: center;"> </div> <p style="text-align: center;">설계모멘트가 완만하게 변하는 것처 철근의 본수를 감소시킨다. 전단력이 큰 부분에서 철근본수를 격감시키는 것은 좋지 않다.</p>		

안전성 검토	부재의 연속성	4.5.2
<div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>20-D29 D10-□- s 100</p> </div> <div style="text-align: center;"> </div> <div style="text-align: center;"> <p>8-D25 2-D25</p> </div> </div> <p>(a) 기둥주근량과 보강철근량의 평형      (b) 보의 상하철근량의 평형과 단부 축앙의 평형      (c) 좌우보의 연속성</p>		