PSC빔 표준화 적정성 검토

제공처 : 한국도로공사 설계처

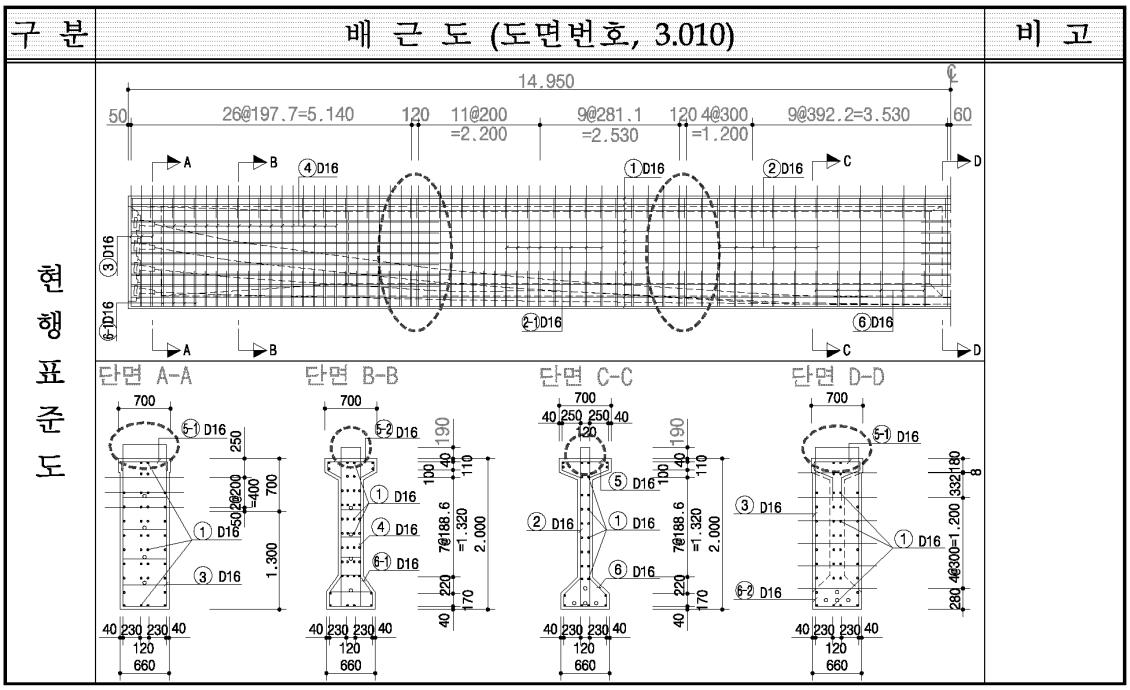
출처 : 2005년도 고속도로 설계 실무자료집(2006, 한국도로공사)

1. 일반현황

현재 고속도로 건설공사 표준도의 P.S.C Beam은 설계최적화를 위한 가로보 개수 축소(7→3EA) 및 등방배근에 따른 슬래브 두께 조정(T=25cm→24cm)에 빔본체 철근배근이 반영되지 않아 상세 검토를 통해 보다 합리적인 배근방안을 제시코자 함

2. 현황 및 문제점

2.1 현행 표준도



2.2 문제점

(1) 가로보가 삭제된 부위의 철근량 과다로 시공성 및 경제성 불량

(2) 수직 전단철근 배치간격중 일부가 소수점 이하 단위로 배근되어 시공성 불량 및 바닥판 철근과 상호간섭 발생

(3) 빔상단 철근 돌출길이(19cm) 부적정(등방배근의 바닥판 두께는 24cm로 상부 피복 6cm를 고려할 경우 18cm가 적당)

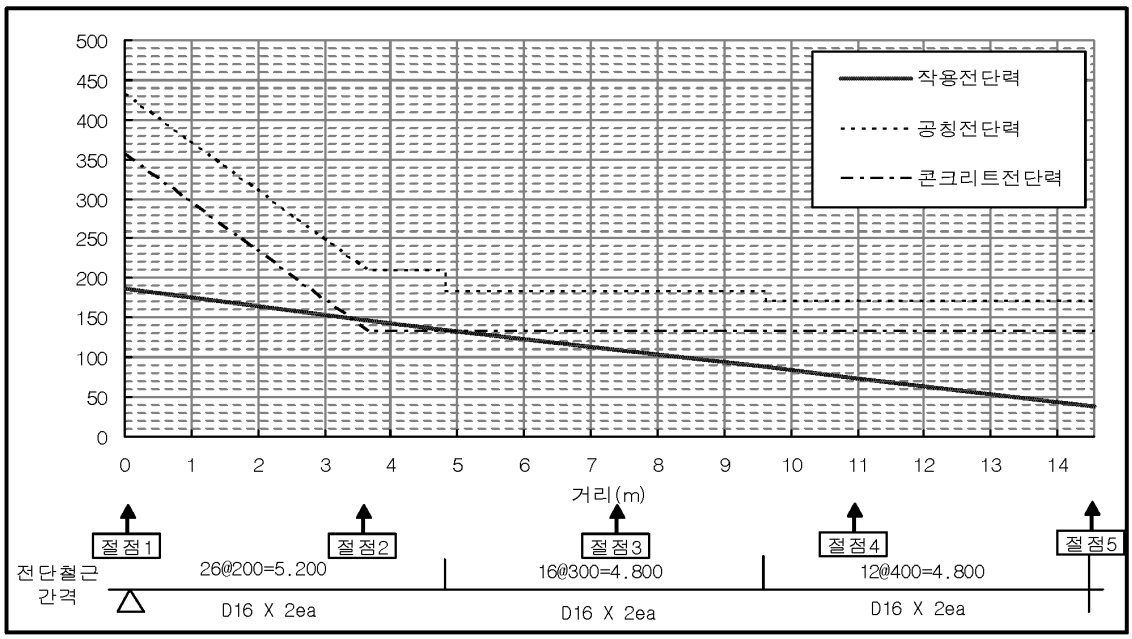
3. 개선내용

3.1 검토내용

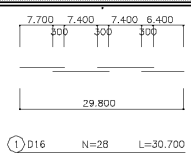
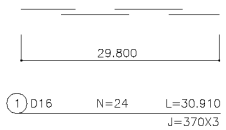
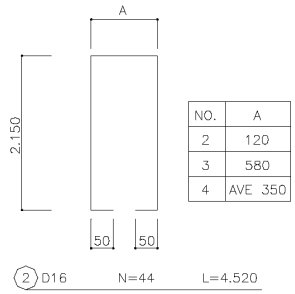
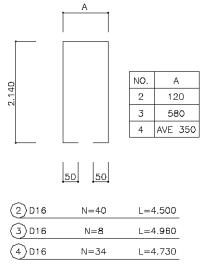
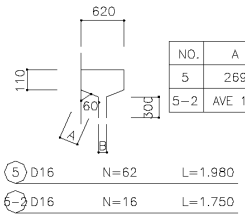
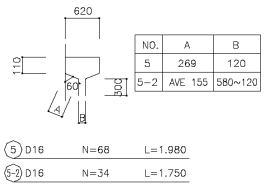
(1) 전단철근 검토

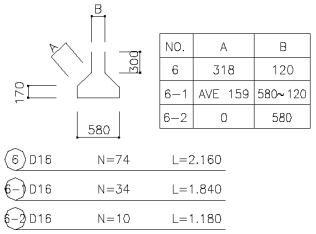
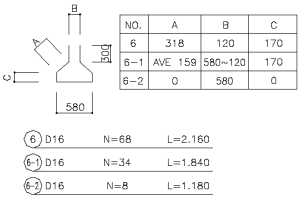
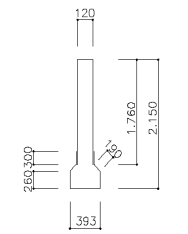
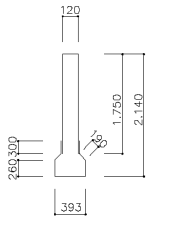
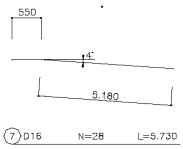
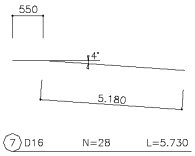
(1.1) 현행 P.S.C BEAM (30m형)의 구조검토 결과 전단철근량에 다소 안전측으로 배근되어 있는 것으로 나타남

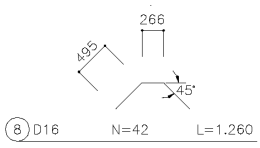
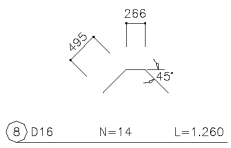
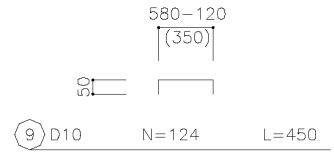
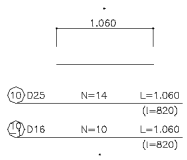
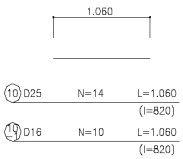
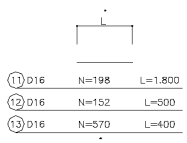
구 분	절점 1 (지점부)	절점 2 (지점에서 3.6375m)	절점 3 (지점에서 7.275m)	절점 4 (지점에서 10.9125m)
전단력 (Vu)	186.606 tonf	146.739 tonf	110.922 tonf	75.105 tonf
필요철근량	1.540㎠ C.T.C 200	0.745㎠ C.T.C 200	0.700㎠ C.T.C 300	0.933㎠ C.T.C 400
현행 사용철근량	D16 X 2 ea= 3.972㎠ C.T.C 197.7	D16 X 2 ea= 3.972㎠ C.T.C 197.7	D16 X 2 ea= 3.972㎠ C.T.C 281.1	D16 X 2 ea= 3.972㎠ C.T.C 392.2
검 토 안	D16 X 2 ea= 3.972㎠ C.T.C 200	D16 X 2 ea= 3.972㎠ C.T.C 200	D16 X 2 ea= 3.972㎠ C.T.C 300	D16 X 2 ea= 3.972㎠ C.T.C 400

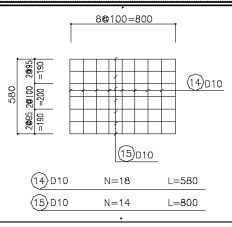
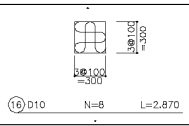
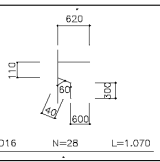
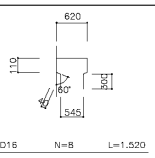
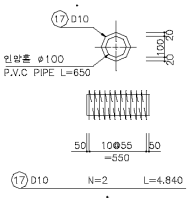
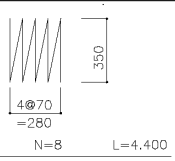


(2) 철근상세분석

철근 NO.	철근 명칭		배근도-2의 철근상세도(도면번호, 3.011)	
			현 행	제 시 안
①	종방향 철근			
	산출 근거	길이	① : 29.900-0.05x2+0.3x3 = 30.700	① : 29.900-0.05x2+0.37x3 = 30.910
		수량	① : 10 x 2 + 4 x 2 = 28 EA	적절함
	변경내용			이음길이 수정
② ③ ④	복부전단 철근		 NO. A 2 120 3 580 4 AVE 350	 NO. A 2 120 3 580 4 AVE 350
	산출 근거	길이	② : 2.150x2+0.12+0.05x2 = 4.520 ③ : 2.150x2+0.58+0.05x2 = 4.980 ④ : 2.150x2+0.35+0.05x2 = 4.750	② : 2.140x2+0.12+0.05x2 = 4.500 ③ : 2.140x2+0.58+0.05x2 = 4.960 ④ : 2.140x2+0.35+0.05x2 = 4.730
		수량	② : 22 x 2 = 44 EA ③ : 3 x 2 + 1 x 2 = 8 EA ④ : 17 x 2 = 34 EA	② : 20 x 2 = 40EA ③ : 3 x 2 + 1 x 2 = 8EA ④ : 17 x 2 = 34EA
	변경내용			*빔 상단 돌출 길이 18cm로 적용, 강선과 간섭되지 않는 부분까지 배근 *철근 개수 수정
⑤ ⑤-2	상부플랜지 전단연결 철근		 NO. A B 5 269 120 5-2 AVE 155 580~120	 NO. A B 5 269 120 5-2 AVE 155 580~120
	산출 근거	길이	⑤ : 0.62+0.11x2+0.269x2+0.3x2 =1.980 ⑤-2 :0.62+0.11x2+0.155x2+0.3x2 =1.750	적절함
		수량	⑤ : 56 EA ⑤-2 : 8 x 2 = 16 EA	⑤ : 34 x 2 = 68EA ⑤-2 : 17 x 2 = 34EA
	변경내용			*하부플랜지 전단 연결철근과 동일하게 배근 *철근 개수 수정

철근 NO.	철근 명칭		배근도-2의 철근상세도(도면번호, 3.011)	
			현 행	제 시 안
⑥ ⑥-1 ⑥-2	하부플랜지 전단연결 철근		 ⑥ D16 N=74 L=2.160 ⑥-1 D16 N=34 L=1.840 ⑥-2 D16 N=10 L=1.180	 ⑥ D16 N=68 L=2.160 ⑥-1 D16 N=34 L=1.840 ⑥-2 D16 N=8 L=1.180
	산출 근거	길이	⑥ : 0.58+0.17x2+0.318x2+0.3x2 = 2.160 ⑥-1 :0.58+0.17x2+0.150x2+0.3x2 =1.640 ⑥-2 : 0.58+0.17x2+0.3x2=1.160	적절함
		수량	⑥ : 37 x 2 = 74 EA ⑥-1 : 17 x 2 = 34 EA ⑥-2 : 10 EA	⑥ : 34 x 2 = 68 EA ⑥-1 : 17 x 2 = 34 EA ⑥-2 : 3 x 2 + 1 x 2 = 8 EA
	변경내용			표현수정, 철근개수 수정
②-1	상부플랜지 보강철근		 ②-1 D16 N=38 L=5.530	 ②-1 D16 N=28 L=5.510
	산출 근거	길이	②-1 : 1.76x2+0.12+0.393+0.26x2 +0.19x2+0.3x2 = 5.530	②-1 :1.75x2+0.12+0.393+0.26x2 +0.19x2+0.3x2 = 5.510
		수량	②-1 : 19 x 2 = 38 EA	②-1 : 14 x 2 = 28EA
	변경내용			*강선과 철근의 간섭방지 *철근 개수 수정
⑦	복부 변화구간 수평전단 철근		 ⑦ D16 N=28 L=5.730	 ⑦ D16 N=28 L=5.730
	산출 근거	길이	⑦ : 0.55 + 5.180 = 5.730	⑦ : 0.55 + 5.180 = 5.730
		수량	⑦ : 7 x 2 x 2 = 28 EA	적절함
	변경내용			길이수정

철근 NO.	철근 명칭		배근도-2의 철근상세도(도면번호, 3.011)	
			현 행	제 시 안
⑧	중간 가로보 헌치부 보강철근			
	산출 근거	길이	⑧ : 0.266+0.495x2 = 1.260	적절함
		수량	⑧ : 7 x 2 x 3EA = 42EA	⑧ : 7 x 2 x 1EA = 14 EA
	변경내용			철근 개수 수정
⑨	강 연 선 지지 철근			적절함
	산출 근거	길이	⑨ : 0.35+0.05x2= 0.45	적절함
		수량	⑨ : 124 EA	적절함
⑩ ⑲	가로보연결부 빔노출 철근			
	산출 근거	길이	⑩:내측빔;0.66+0.2x2=1.060 외측빔:(0.66-0.04+0.2=0.820) ⑲:내측빔;0.66 +0.2x2=1.060 외측빔;(0.66-0.04+0.2=0.820)	적절함
		수량	⑩ : 14 EA ⑲ : 8 EA	⑩ : 3x2x2 + 1x2x1=14 EA ⑲ : 5x2x1 = 10 EA
	변경내용			개수 수정
⑪ ⑫ ⑬	정착구 부근 격자보강철근			적절함
	산출 근거	길이	⑪ : 2.000 - 0.1x2 =1.800 ⑫ : 0.660 - 0.08x2 = 0.500 ⑬ : 0.660 - 0.02x2 + 0.11x2 = 0.400	적절함
		수량	⑪ : (4x6 + 15x5) x 2 = 198 EA ⑫ : 19 x 4 x.2 = 152 EA ⑬ : 19 x 15 x 2 = 570 EA	적절함

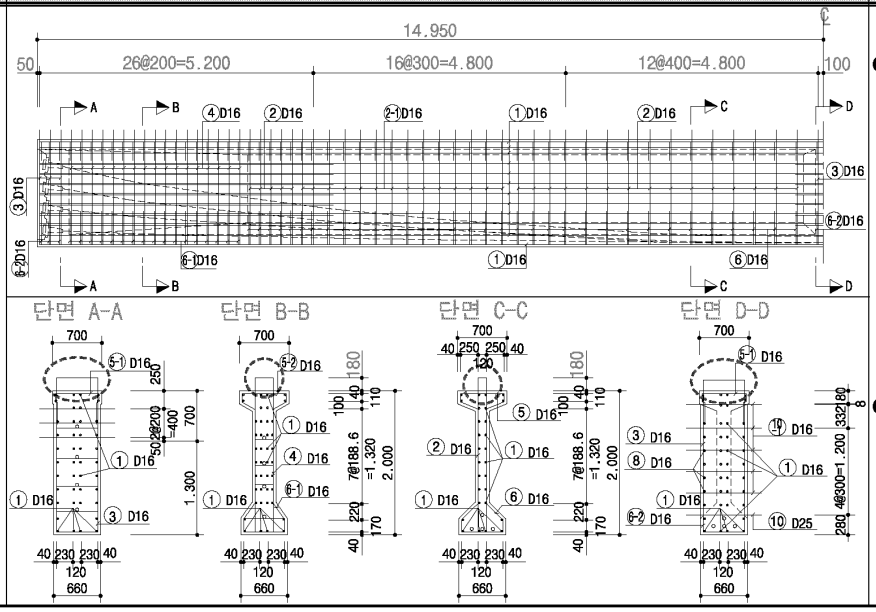
철근 NO.	철근 명칭		배근도-2의 철근상세도(도면번호, 3.011)	
			현 행	검 토 안
⑭ ⑮	교량받침부 지압보강 철근			적절함
	산출 근거	길이	⑭ : 0.580 , ⑮ : 0.800	적절함
		수량	⑭ : 18 EA, ⑮ : 14 EA	적절함
⑯	정착구 보강철근			적절함
	산출 근거	길이	⑯ : 2.870	적절함
		수량	⑯ : 4 x 2 = 8 EA	적절함
⑤-1	상부플랜지 전단연결철근 (가로보부근)			
	산출 근거	길이	⑤-1 : 0.62 +0.11+0.04+0.3 =1.070	⑤-1 : 0.62 +0.11x2+0.04x2+0.3x2 =1.520
		수량	⑤-1 : 7 x 2 x 2 = 28 EA	⑤-1 : 3 x 2 + 1 x 2 =8EA
	변경내용			철근 길이 및 개수 수정
⑰	인 양 홀 보강철근			적절함
	산출 근거	길이	⑰ : 4.840	적절함
		수량	⑰ : 2 EA	적절함
⑱	긴 장 부 보강철근			적절함
	산출 근거	길이	⑱ : 4.400	적절함
		수량	⑱ : 6 EA	적절함

4. 결론

(1) 수직 전단철근 배치간격 조정을 통해 시공성 증대 및 바닥판 철근과의 상호 간섭 발생을 최소화하고

(2) 빔상단 철근 돌출길이는 등방배근의 바닥판 두께 24cm를 고려하여 조정(19cm→18cm)하며

(3) 철근배치도와 상세도는 변경 표준도로 시행함이 타당할 것으로 판단됨

구 분	배 근 도 (도면번호, 3.010)	비 고
검토결과		o 수직전단 철근 배치 간격을 등간격의 정치수로 변경 o 빔상단 돌출길이 조정(19㎝ →18㎝)

5. 기타

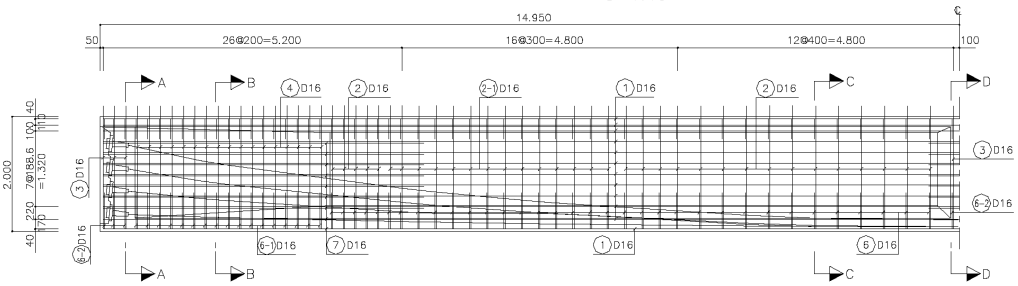
5.1 변경 표준도

P.S.C BEAM

배근도-1 (L=30.0m)

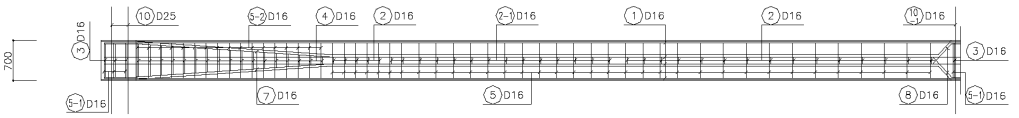
평 면 도

S=1:40

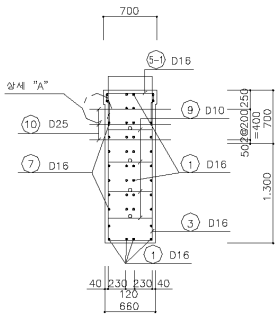


측 면 도

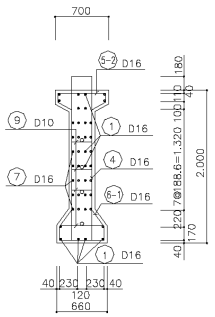
S=1:40



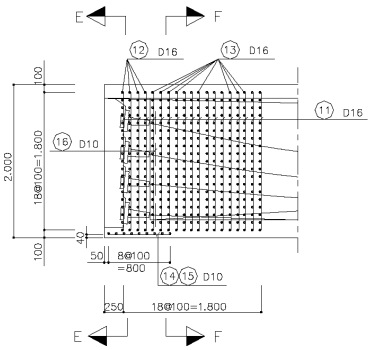
단 면A-A



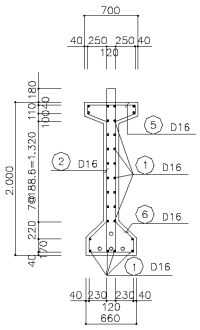
단 면B-B



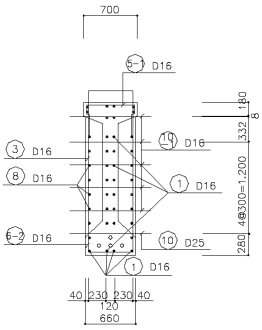
단 부 보 강



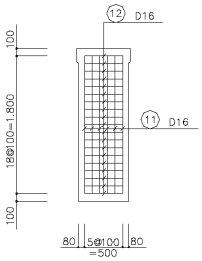
단 면C-C



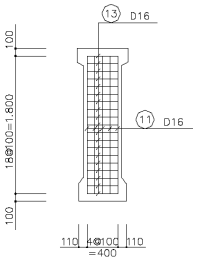
단 면D-D



단 면E-E



단 면F-F



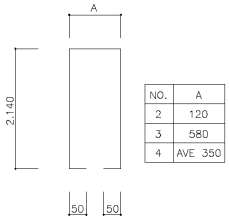
* 주 : 단면 A-A의 철근번호 (10)은 교량의 신축이음이 설치되지 않는 구간(슬래브 연속처리부)에 한해서는 단면 D-D의 철근 (10) (10-1)과 동일한 방법으로 배근한다.

P.S.C BEAM
배근도-2 (L=30.0m)

철 근 상 세 도

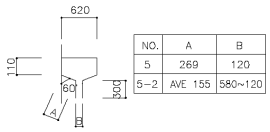


① D16 N=28 L=30.910
J=370X3



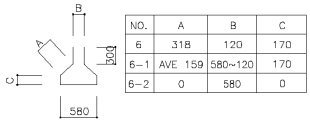
NO.	A
2	120
3	580
4	AVE 350

② D16 N=40 L=4.500
③ D16 N=8 L=4.960
④ D16 N=34 L=4.730



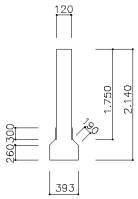
NO.	A	B
5	269	120
5-2	AVE 155	580~120

⑤ D16 N=68 L=1.980
⑤-2 D16 N=34 L=1.750

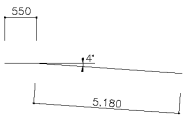


NO.	A	B	C
6	318	120	170
6-1	AVE 159	580~120	170
6-2	0	580	0

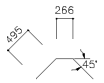
⑥ D16 N=68 L=2.160
⑥-1 D16 N=34 L=1.840
⑥-2 D16 N=8 L=1.180



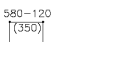
②-1 D16 N=28 L=5.510



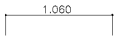
⑦ D16 N=28 L=5.730



⑧ D16 N=14 L=1.260



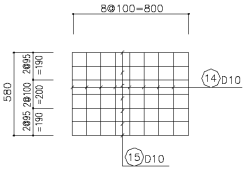
⑨ D10 N=124 L=450



⑩ D25 N=14 L=1.060
(l=820)
⑩ D16 N=10 L=1.060
(l=820)



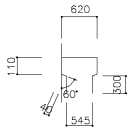
⑪ D16 N=198 L=1.800
⑫ D16 N=152 L=500
⑬ D16 N=570 L=400



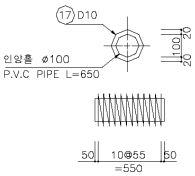
⑭ D10 N=18 L=580
⑮ D10 N=14 L=800



⑯ D10 N=8 L=2.870

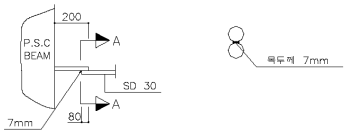


⑤-1 D16 N=8 L=1.520



⑰ D10 N=2 L=4.840
⑱ D16 N=8 L=4.400

상 세 "A" 단 면 A-A



철 근 재 료 표

(SD 30) (형1개당)

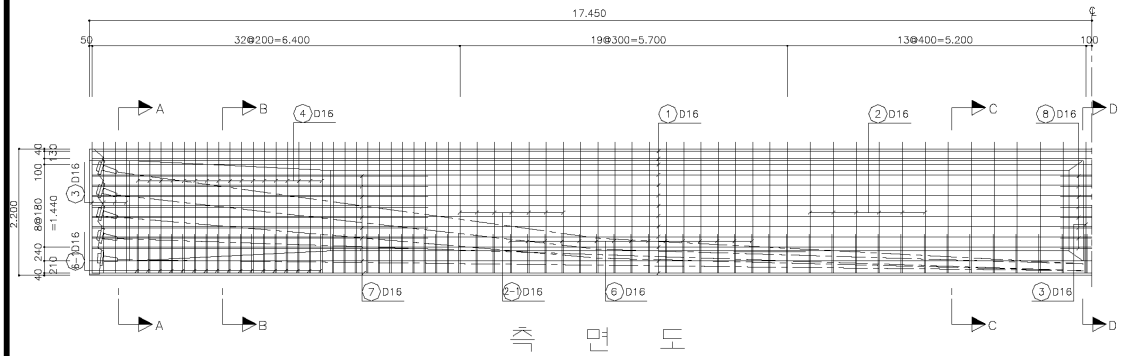
번호	직경	길이 (m)	갯수 (EA)	총길이 (m)	단위중량 (kgf/m)	총중량 (kgf)	비고 (tanf)
10	D25	1.060 (820)	14	14.840 (11.480)			ADD 3%
소계				14.840 (11.480)	3.980	59.063 (45.690)	0.061 (0.047)
1	D16	30.910	28	865.480			
2	"	4.500	40	180.000			
2-1	"	5.510	28	154.280			
3	"	4.960	8	39.680			
4	"	4.730	34	160.820			
5	"	1.980	68	134.640			
5-1	"	1.520	8	12.160			
5-2	"	1.750	34	59.500			
6	"	2.160	68	146.880			
6-1	"	1.840	34	62.560			
6-2	"	1.180	8	9.440			
7	"	5.730	28	160.440			
8	"	1.260	14	17.640			
10-1	"	1.060 (820)	10	10.600 (8.200)			
11	"	1.800	198	356.400			
12	"	500	152	76.000			
13	"	400	570	228.000			
18	"	4.400	8	35.200			
소계				2709.720 (2707.320)	1.560	4227.163 (4223.419)	4.354 (4.350)
9	D10	450	124	55.800			
14	"	580	18	10.440			
15	"	800	14	11.200			
16	"	2.870	8	22.960			
17	"	4.840	2	9.680			
소계				110.080	0.560	61.645	0.063
총계							4.478 (4.460)

주) ( )안의 지수는 외측BEAM 수량임.

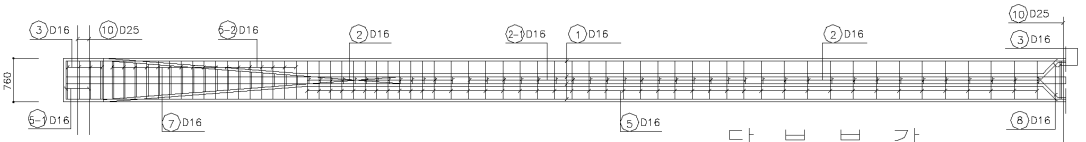
P.S.C BEAM

배근도 - 1 (L=35.0m)

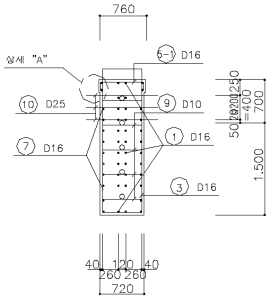
평 면 도



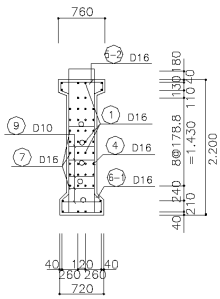
측 면 도



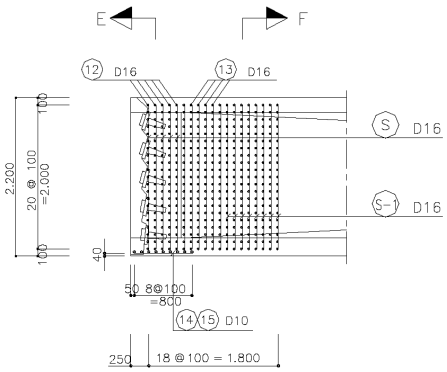
단 면 A-A



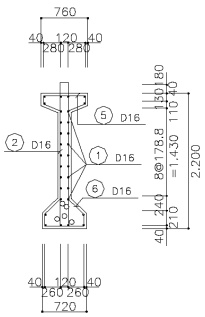
단 면 B-B



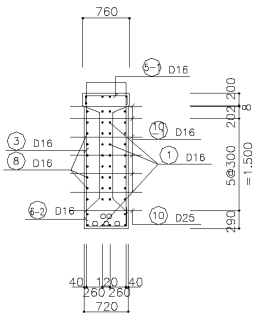
단 부 보 강



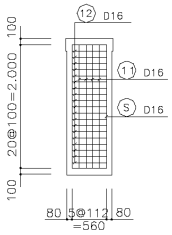
단 면 C-C



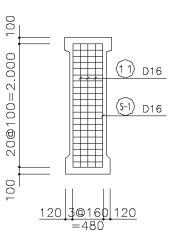
단 면 D-D



단 면 E-E



단 면 F-F

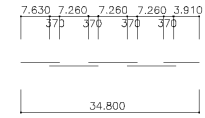


* 주 : 단면 A-A의 철근번호 (10) 은 교량의 신축이음이
설치되지 않는 구간(슬래브 연속처리부)에 한해서는
단면 D-D의 철근 (10)-1 과 동일한 방법으로 배근한다.

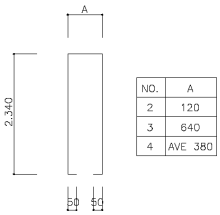
P.S.C BEAM

배근도-2 (L=35.0m)

철 근 상 세 도

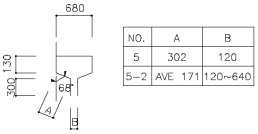


① D16 N=30 L=36,280
J=370X4



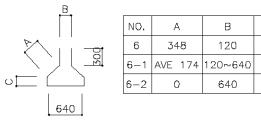
NO.	A
2	120
3	640
4	AVE 380

② D16 N=52 L=4,900
③ D16 N=10 L=5,420
④ D16 N=34 L=5,160



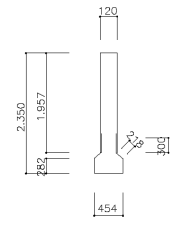
NO.	A	B
5	302	120
5-2	AVE 171	120~640

⑤ D16 N=86 L=2,140
⑤-2 D16 N=34 L=1,880

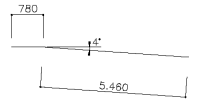


NO.	A	B	C
6	348	120	210
6-1	AVE 174	120~640	210
6-2	0	640	0

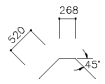
⑥ D16 N=86 L=2,360
⑥-1 D16 N=34 L=2,010
⑥-2 D16 N=10 L=1,240



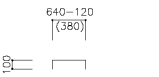
⑦-2 D16 N=34 L=6,090



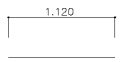
⑦ D16 N=32 L=6,240



⑧ D16 N=16 L=1,310



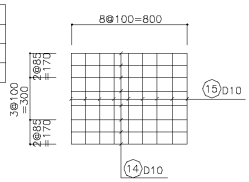
⑨ D10 N=180 L=580



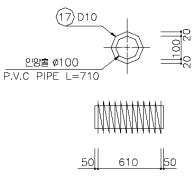
⑩ D25 N=14 L=1,120
(l=880)
⑭ D16 N=12 L=1,120
(l=880)



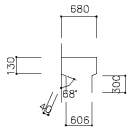
⑪ D16 N=124 L=2,000
⑫ D16 N=210 L=560
⑬ D16 N=588 L=480



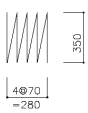
⑭ D10 N=16 L=800
⑮ D10 N=18 L=640



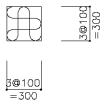
⑰ D10 N=2 L=5,370



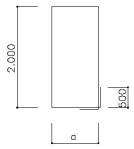
⑤-1 D16 N=10 L=1,620



⑱ D16 N=10 L=4,400

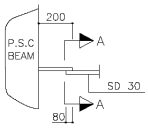


⑯ D10 N=10 L=2,870



⑤ D16 a=640 N=10 L=6,280
⑤-1 D16 a=485~560 N=28 L=6,050

상 세 "A"



단 면 A-A



철 근 재 료 표

(SD 30) (형1개당)

번 호	직 경	길 이 (m)	갯 수 (EA)	총 길 이 (m)	단위중량 (kgf/m)	총 중 량 (kgf)	비 고 (tonf)
10	D25	1,120 880	14	15,680 (12,320)			ADD 3%
	소	계		15,680 (12,320)	3.980	62,406 (49,034)	0.064 (0.051)
1	D16	36,280	30	1088.400			
2	"	4.900	52	254.800			
2-1	"	6.090	34	207.060			
3	"	5.420	10	54.200			
4	"	5.160	34	175.440			
5	"	2.140	86	184.040			
5-1	"	1.620	10	16.200			
5-2	"	1.880	34	63.920			
6	"	2.360	86	202.960			
6-1	"	2.010	34	68.340			
6-2	"	1.240	10	12.400			
7	"	6.240	32	199.680			
8	"	1.310	16	20.960			
10-1	"	1,120 880	12	13,440 (10,560)			
11	"	2.000	124	248.000			
12	"	560	210	117.600			
13	"	480	588	282.240			
18	"	4.400	10	44.000			
S	"	6.280	10	62.800			
S-1	"	6.050	28	169.400			
	소	계		3485.880 (3483.000)	1.560	5437.973 (5433.480)	5.601 (5.596)
9	D10	580	180	104.400			
14	"	800	16	12.800			
15	"	640	18	11.520			
16	"	2.870	10	28.700			
17	"	5.370	2	10.740			
	소	계		168.160	0.560	94.170	0.097
	총	계					5.762 (5.744)

주) ( )안의 치수는 외측BEAM 수량임.