# 삼천포대교의 설계와 시공

대림산업
창선-삼천포교량현장

# 1. 창선-삼천포교량 공사개요

- 목적 : 남해군과 사천시 연결
  도서지역 개발 및 한려해상 국립공원의 관광자원 활성화
- 노선명 : 국도 3호선 (남해~초산)
- 위 치 : 경남 남해군 창선면 ~ 사천시 대방동
- 사업량 :
  - 총연장 : 3.4 km (대림산업 공사구간 : 1.3 km)
  - 주요구조물 : 교량 7개소 (엉개교,단항대교,늑도교,
    초양접속교, 초양대교, 삼천포대교, 삼천포접속교)
- 총공사비 : 1,820억원 (시설비:1,644억, 용지비:176억)
  (대림산업:969억, 한진중공업:675억)

# 2. 주요 교량

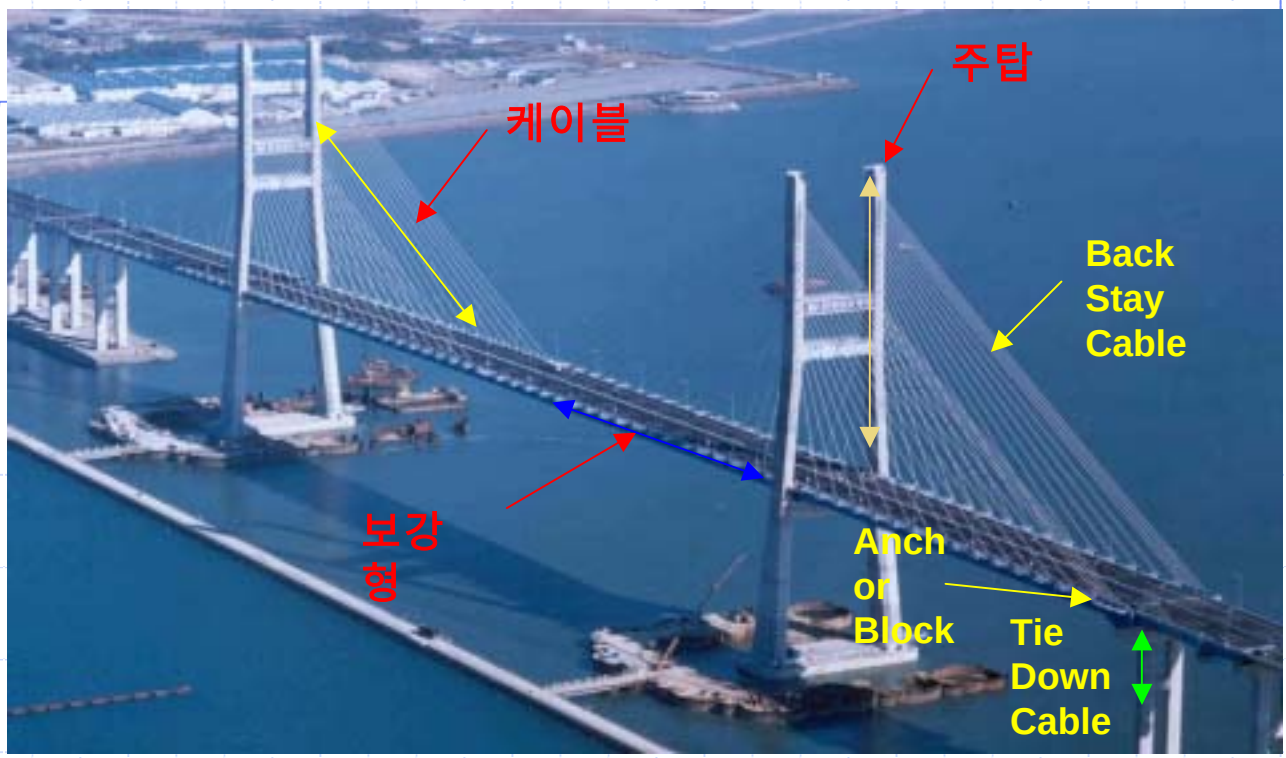
단항대교 : 하로식 3경간 Steel 아치교
중앙경간 = 180 m

늑도대교 : FCM 콘크리트 박스교량
중앙경간 = 160 m

초양대교 : 중로식 아치교
중앙경간 = 202 m

삼천포대교 : 강합성사장교
중앙경간 = 230 m

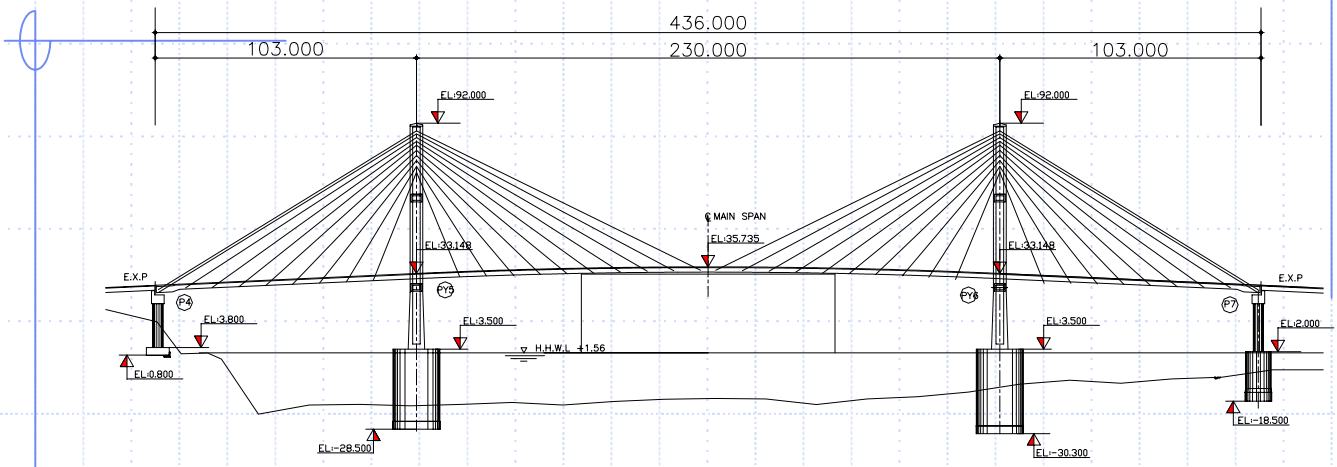
## 3. 사장교 일반사항




## 4. 국내 사장교 현황

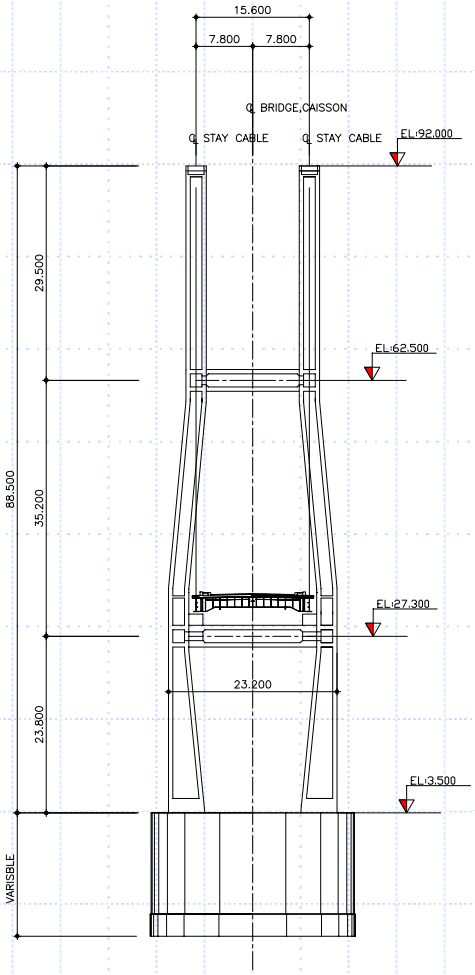
| | 교 량 | 완 공 년 | 시 공 사 | 중앙경간 | 측경간 | 주 탑 | 주 형 | 케이블 |
|---|---|---|---|---|---|---|---|---|
| 1 | 돌산대교 | 1984 | 대림산업 | 280m | 85m | Steel - A형 | Steel Box | LCR |
| 2 | 진도대교 | 1984 | 현대건설 | 344m | 70m | Steel - A형 | Steel Box | LCR |
| 3 | 올림픽대교 | 1990 | 유원건설 | 150m | 150m | 콘크리트 - A형 | 콘크리트 Box | PSC |
| 4 | 신행주대교 | 1995 | 벽산건설 | 120m | 50m | 콘크리트 - 문형 | 콘크리트 Box | PSC |
| 5 | 서해대교 | 2000 | 대림산업 | 470m | 200m | 콘크리트 - H형 | 강합성 | PSC |
| 6 | 영흥대교 | 2001 | 현대건설 | 240m | 110m | Steel -다아몬드형 | Steel Box | PSC |
| 7 | 삼천포대교 | 2002 예정 | 대림산업 | 230m | 103m | 콘크리트 - H형 | 강합성 | PSC |
| 8 | 제2진도대교 | 시공중 | 현대건설 | 344m | 70m | Steel - A형 | Steel Box | New-PWS |

# 5. 삼천포대교 일반

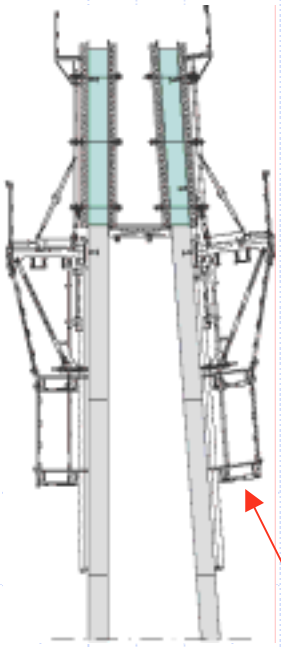


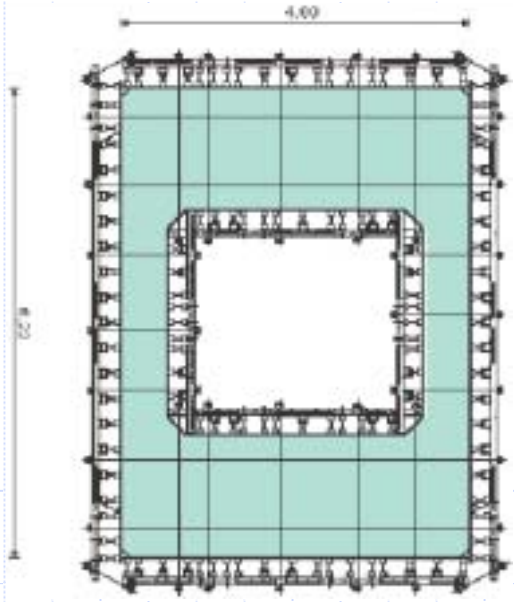

## 5.1 주탑

- H 형상의 철근콘크리트 구조
  : $\sigma_{ck} = 350\, kg/cm^2$
- Semi-Fan Type의 2면 구조
- 하단부 : 6.5 m x 5.0 m
- 상단부 : 5.0 m x 2.8 m
- 가로보 : 4.2 m x 3.0 m



## 5.1.1 주탑 시공 – Cross Beam 하단

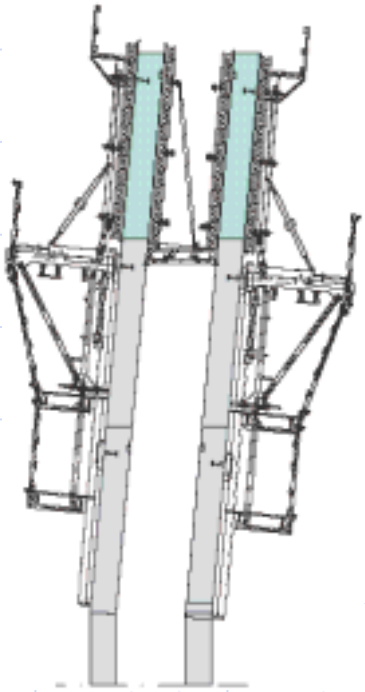


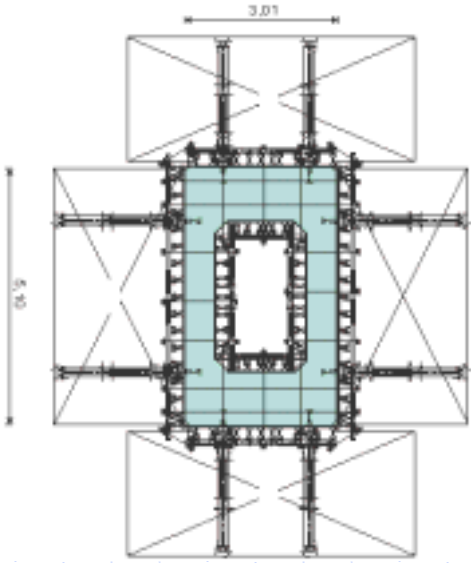


**Auto-Climbing Form (PERI)**

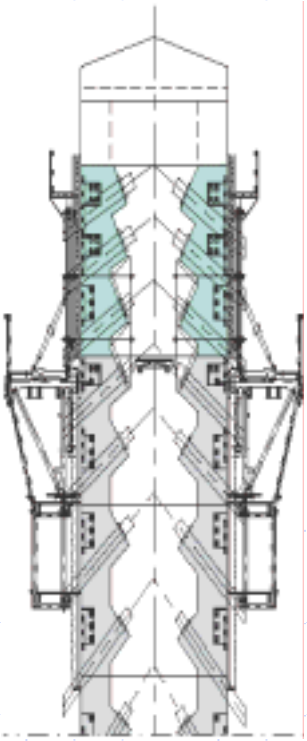
**1 LOT = 3.9 m**

## 5.1.2 주탑 시공 – 중앙부

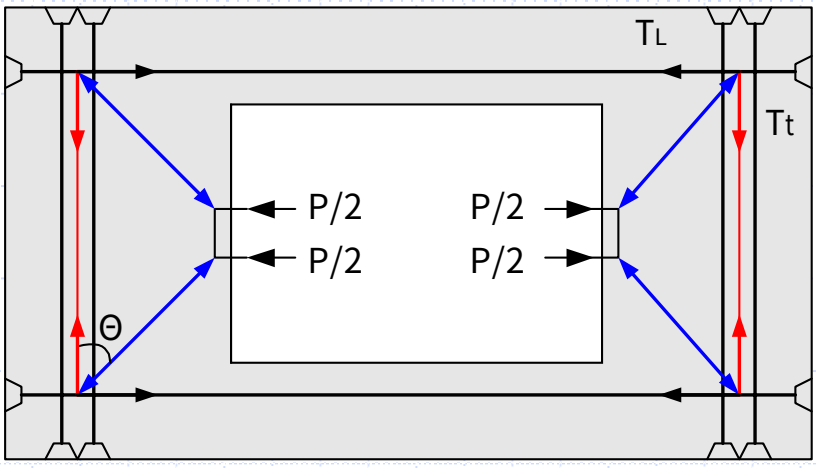


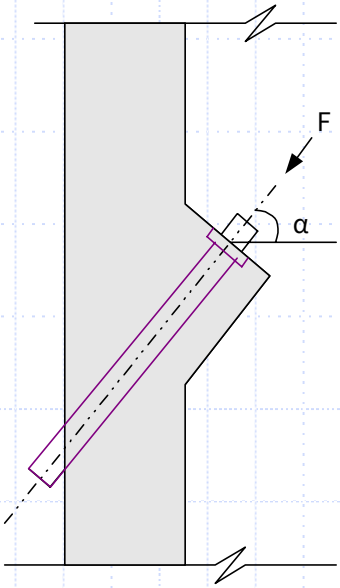


## 5.1.3 주탑 시공 – 정착부



## 5.1.4 주탑 정착부 - PT작업



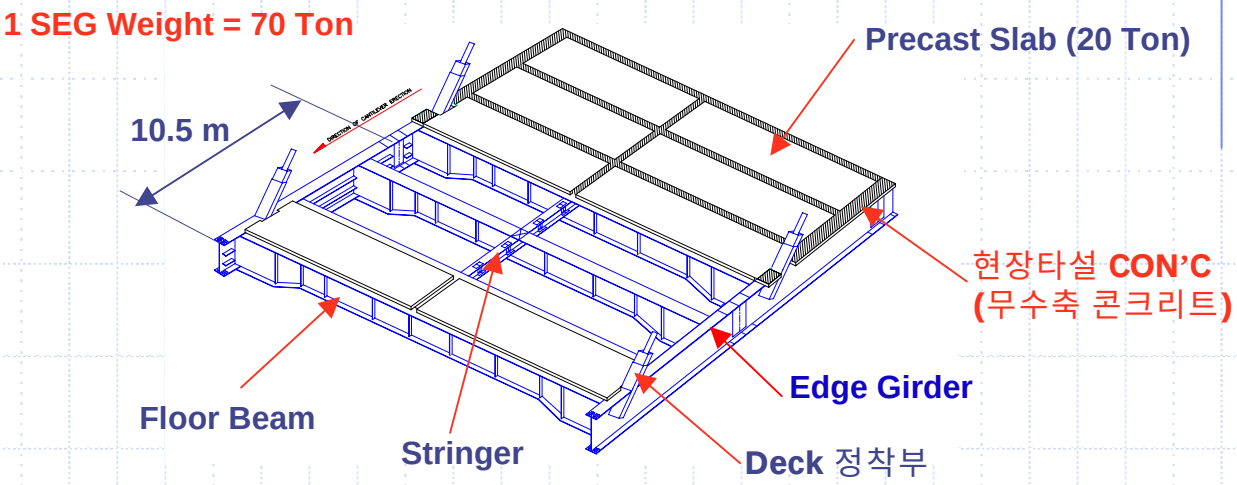




P= F X cosα

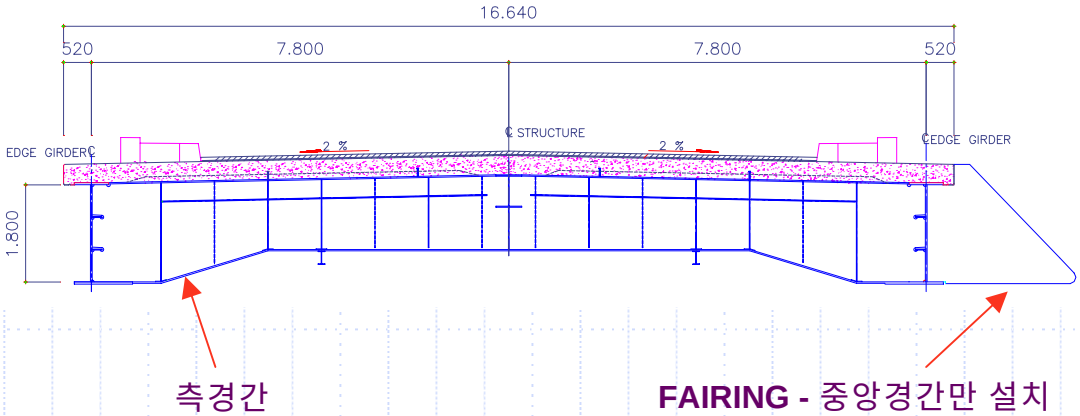
## 5.2 보강형

- 강재 주형과 프리캐스트 콘크리트 바닥판의 합성형

$$\sigma_{ck} = 400\ kg/cm^2$$

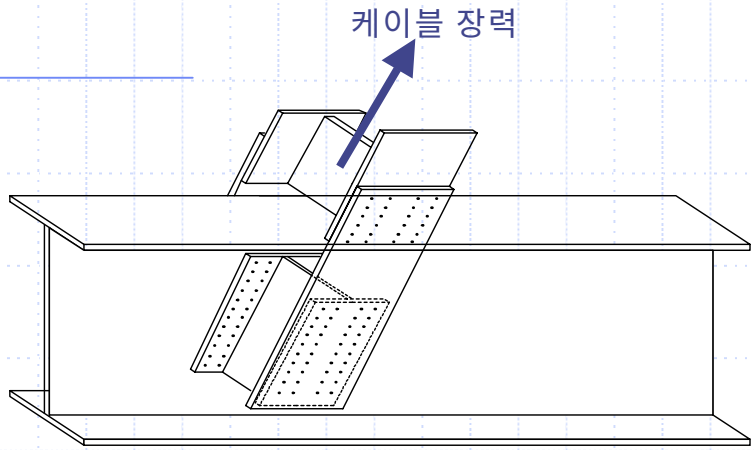


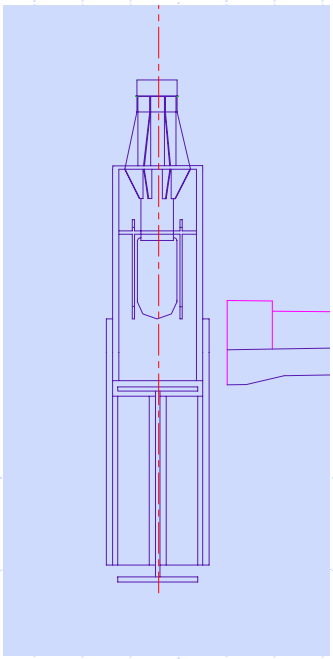

### 5.2.1 보강형 단면




- 강형 사장교에 비해 강성이 크고, 콘크리트 사장교에 비해 자중에 대한 부담이 적다.
- 바닥판을 미리 제작하여 크리프와 건조수축 등에 대한 장기 변형을 최소화시킬 수 있다.
- 시공이 간편하다.

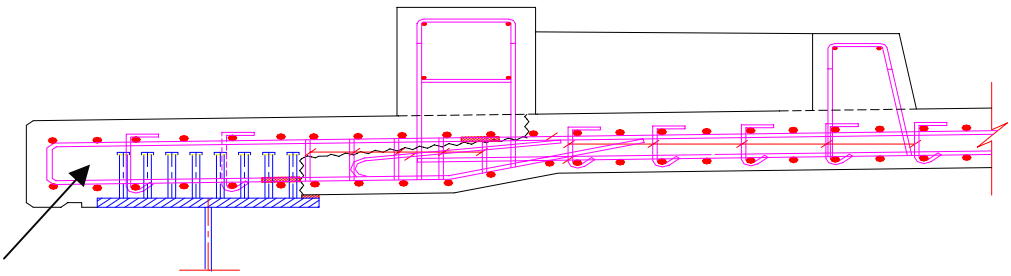
## 5.2.2 보강형 케이블 정착구조



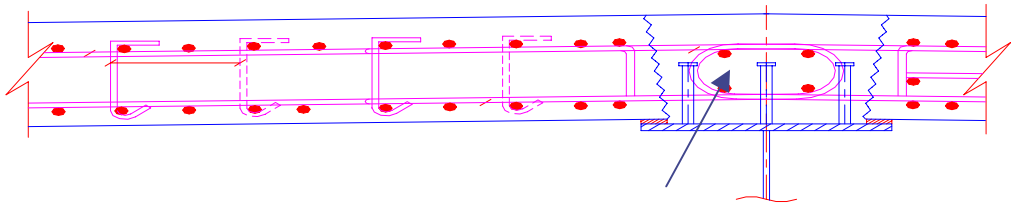



- 피로응력에 유리한 **Bolt** 접합
- **Edge Girder**에 편심이 없는 구조

## 5.2.3 보강형 합성구조



**Side** 현장 타설 **Con'c**

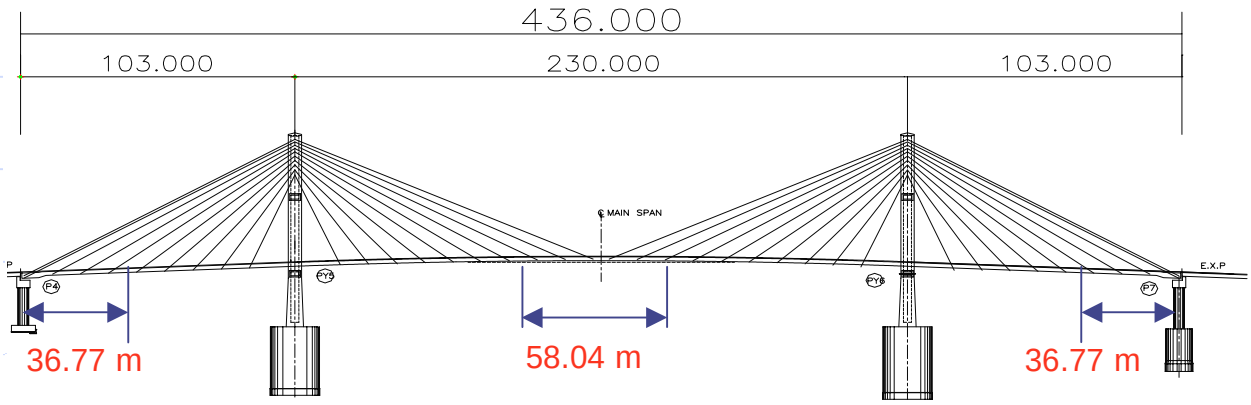


중앙부 현장 타설 **Con'c**

## 5.3 프리캐스트 슬래브 PT 구조

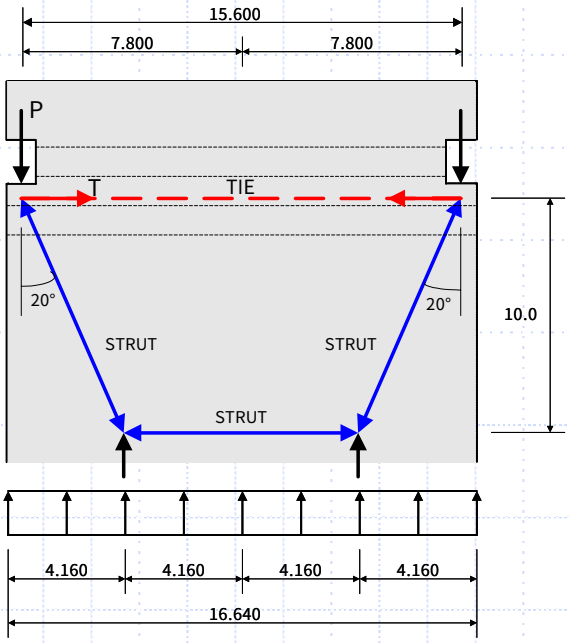
### 5.3.1 프리캐스트 슬래브 PT 구조(I)

종방향 **Deck Prestressing**



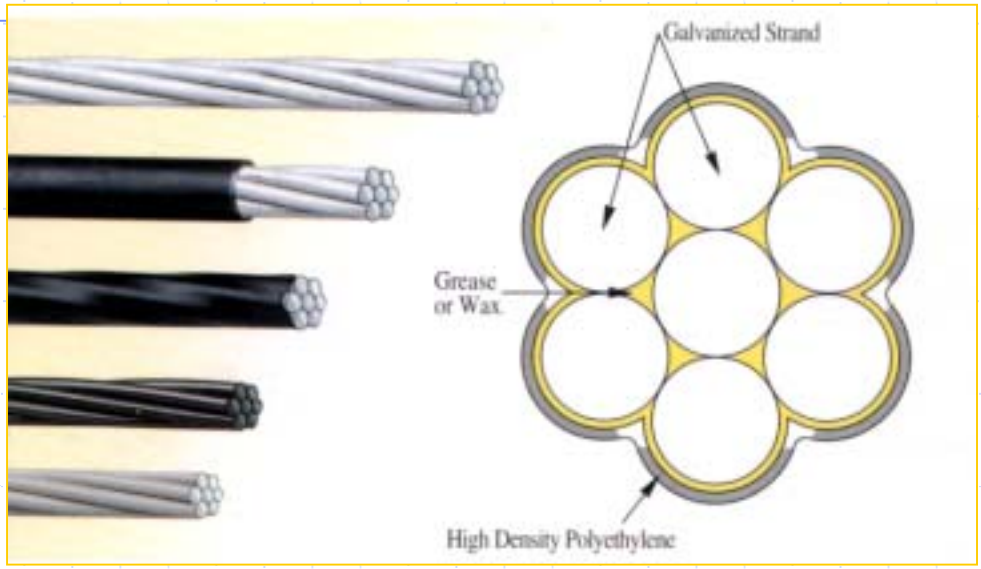

### 5.3.2 프리캐스트 슬래브 PT 구조(II)

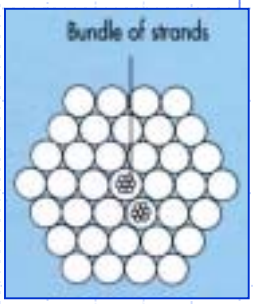
횡방향 **Deck Prestressing**



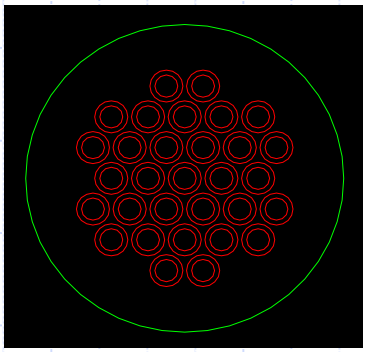
## 5.4 사장재

**Parallel Strand Stay Cable**

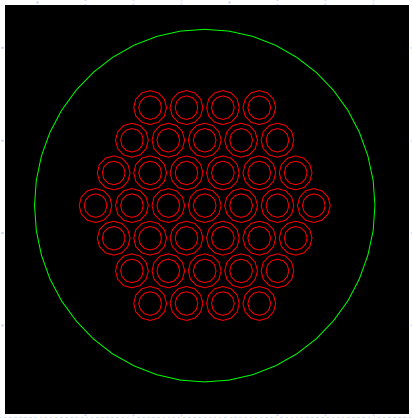


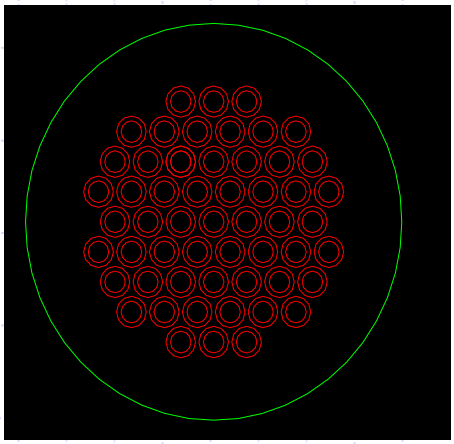

## 5.5 Anchorage Type



**31 Strand**

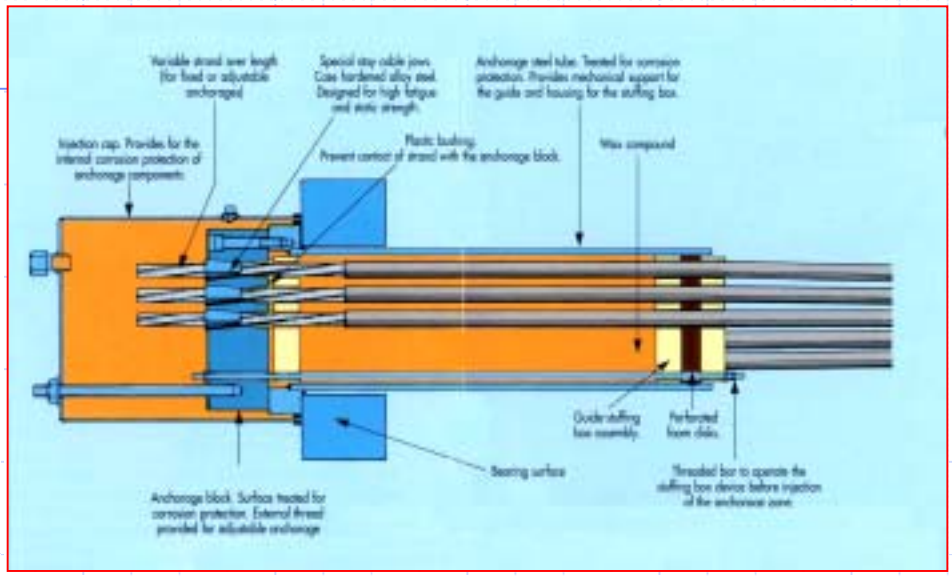


**37 Strand**



**55 Strand**

## 5.6 Deck 정착구

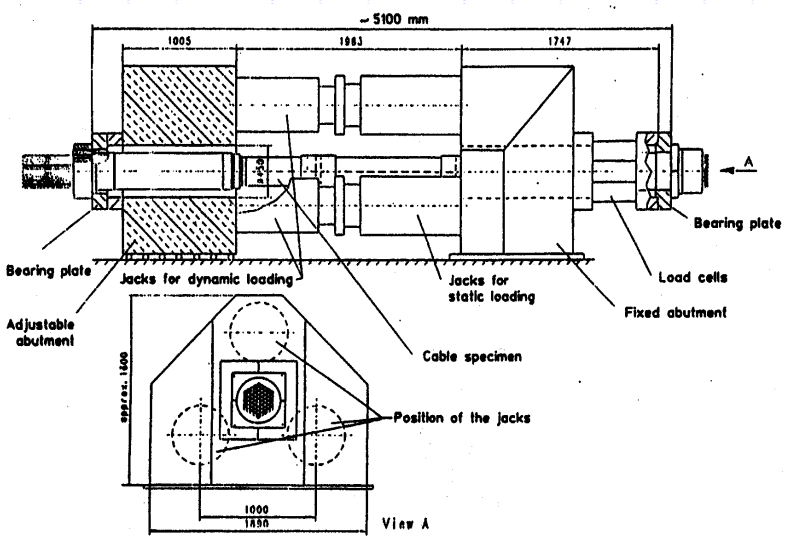



Fixed Anchorage – Dead Anchorage

## 5.7 주탑 정착구

Adjustable Anchorage – Live Anchorage

## 5.8 Fatigue Test



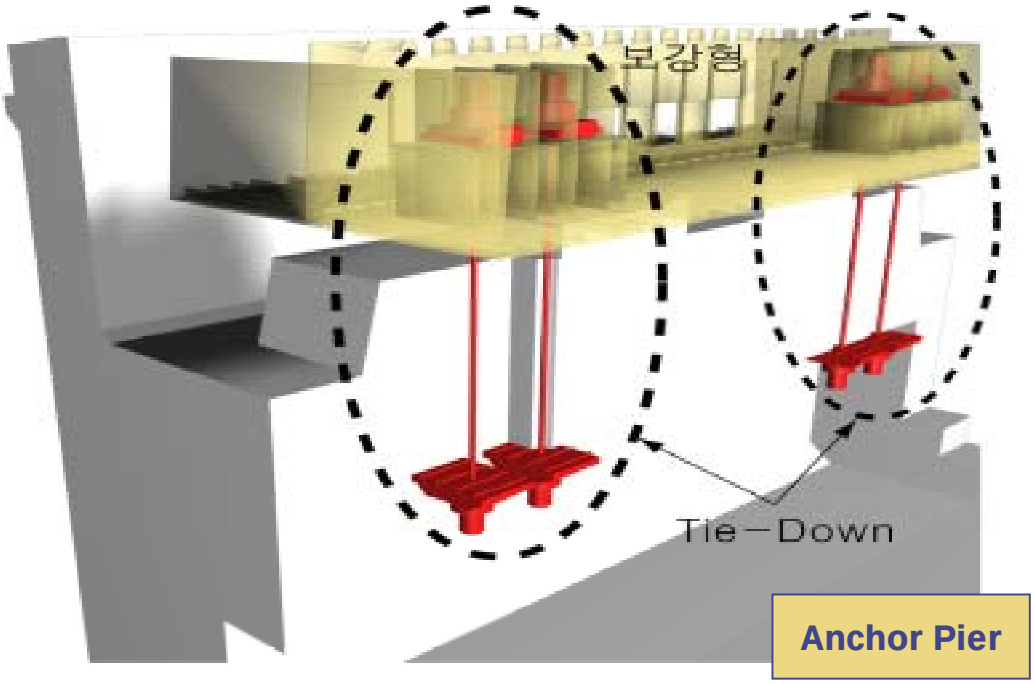

### 5.8.1 Fatigue Test 기준 - PTI

| (1) 스트랜드 자체 피로시험 (매 10 ton 마다) | 반복회수 | 최대하중 (kN) | 최소하중 (kN) | 하중진폭 (kN) |
|---|---|---|---|---|
| 5% | 200만회 | 119.475 | 87.27 | 32.205 |
| 95% | 10만회 | 119.475 | 57.42 | 62.055 |
| 반복시험후 95% Pu까지 하중재하 소선의 파단여부 판단. | | | | |

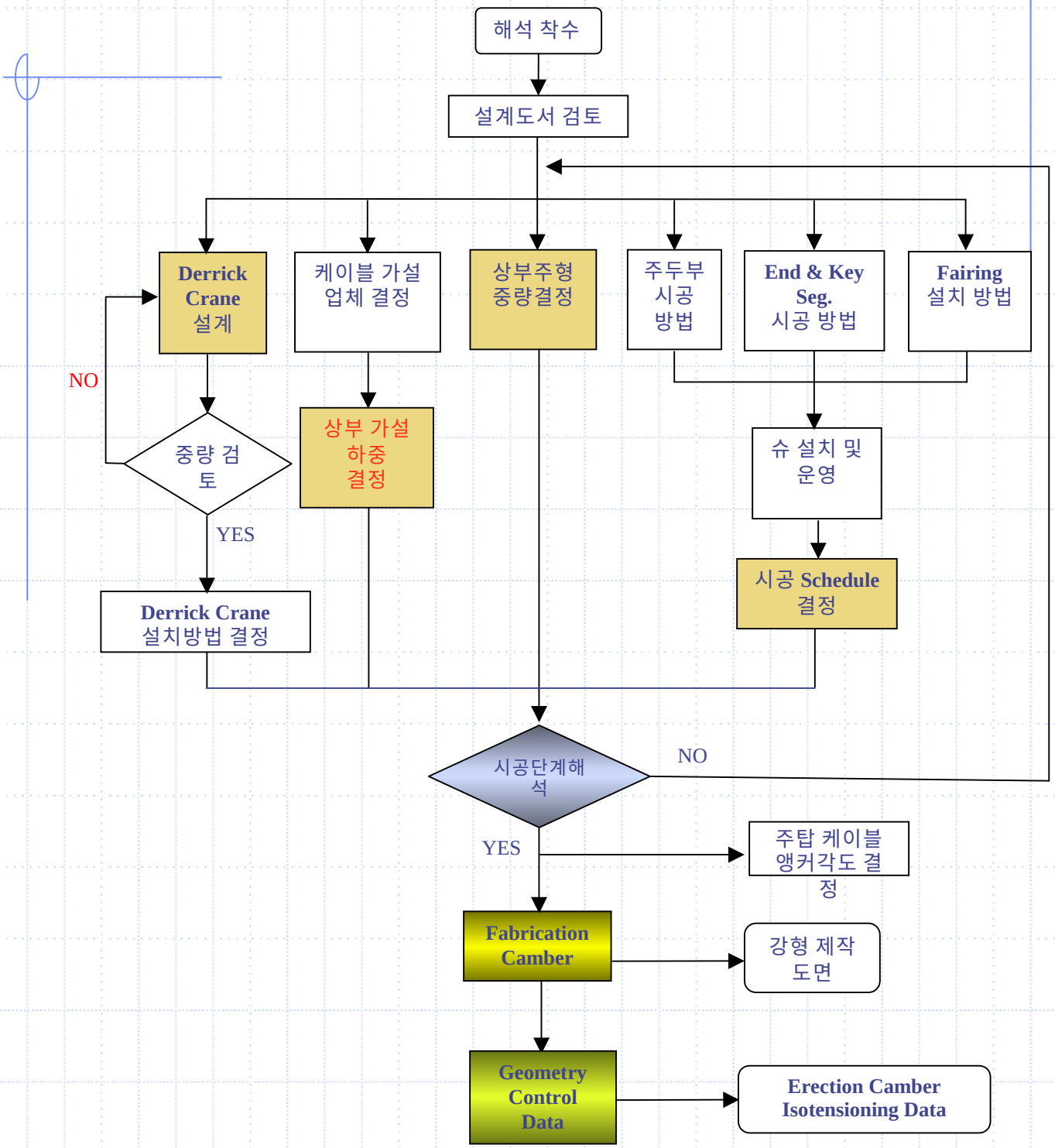
| (2) 정착구와 스트랜드 조합된 피로시험 | 반복회수 | 최대하중 (kN) | 최소하중 (kN) | 하중진폭 (kN) |
|---|---|---|---|---|
| N : 케이블 가닥수 | 200만회 | 119.475 N | 95.685 N | 23.79 N |
| 반복시험후 95% Pu까지 하중재하 소선의 파단여부 판단. PTI기준은 2%까지 허용함. | | | | |

## 5.9 HDPE 관


## 5.10 Tie Down Cable

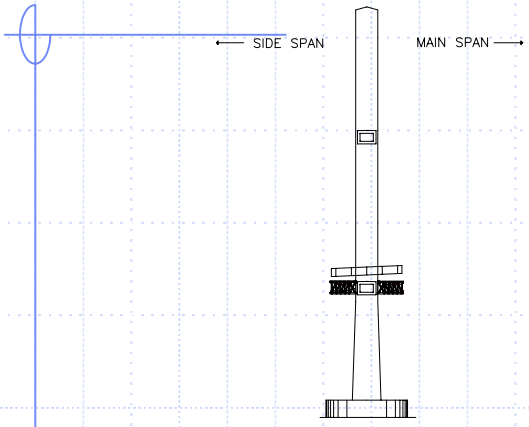


# 6. 시공단계해석

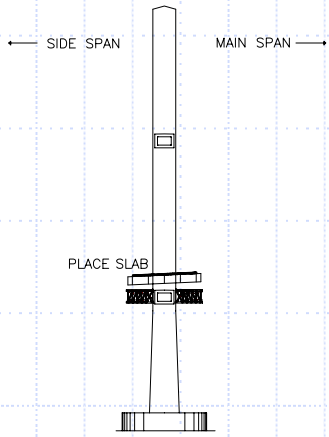

해석 착수
설계도서 검토
Derrick Crane 설계
케이블 가설 업체 결정
상부주형 중량결정
주두부 시공 방법
End & Key Seg. 시공 방법
Fairing 설치 방법
NO
중량 검토
상부 가설 하중 결정
슈 설치 및 운영
YES
시공 Schedule 결정
Derrick Crane 설치방법 결정
시공단계해석
NO
YES
주탑 케이블 앵커각도 결정
Fabrication Camber
강형 제작 도면
Geometry Control Data
Erection Camber Isotensioning Data

# 6.1 주두부 시공순서

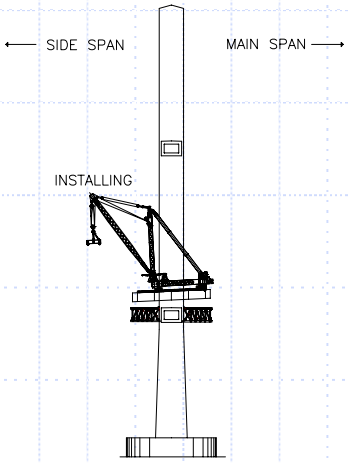
STEP 1 : ERECT STEEL GIRDER L0 & R0



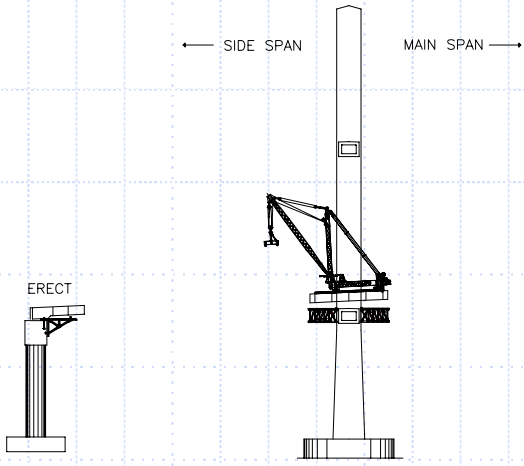

STEP 2 : PLACE SLAB ON L0 & R0



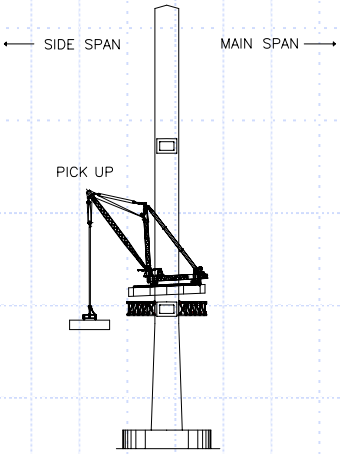

STEP 3 : INSTALL DERRICK CRANE



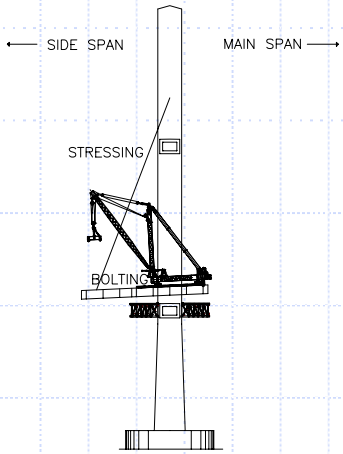

STEP 4 : ERECT STEEL SEG LL9 & RR9



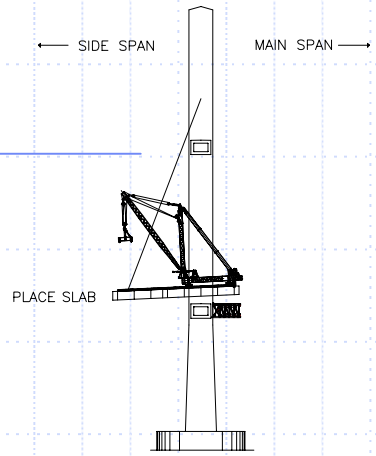

STEP 5 : PICK UP STEEL GIRDER OF SIDE SPAN



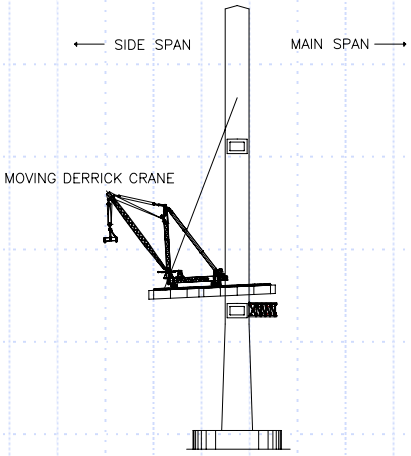

STEP 6 : STRESS CABLE OF SIDE SPAN



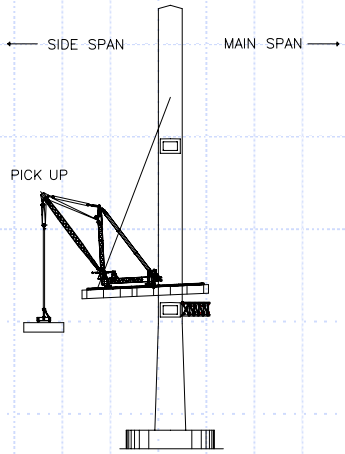
STEP 7 : PLACE SLAB OF SIDE SPAN



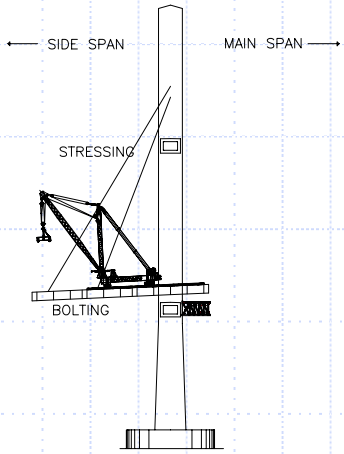

STEP8 : MOVE DERRICK CRANE OF SIDE SPAN



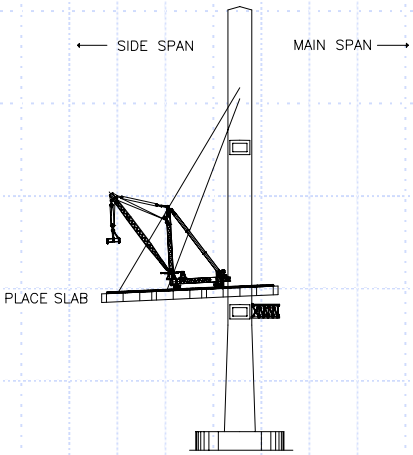

STEP 9 : PICK UP STEEL GIRDER OF SIDE SPAN



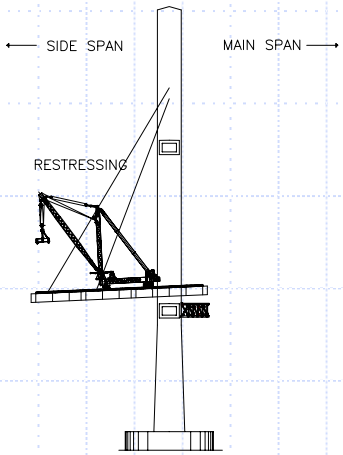

STEP10 : STRESS CABLE OF SIDE SPAN



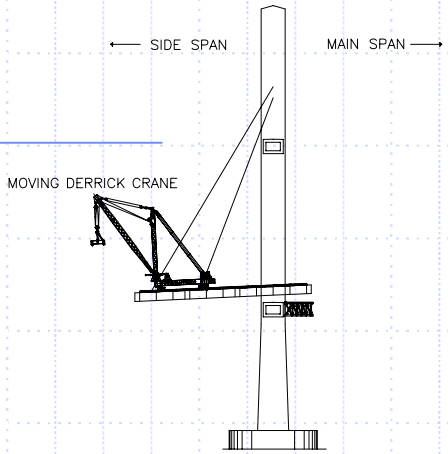

STEP11 : PLACE SLAB OF SIDE SPAN



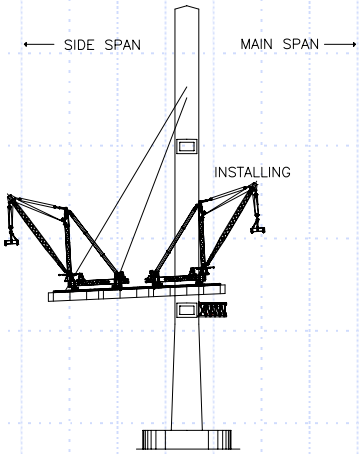

STEP12 : RESTRESS CABLE OF SIDE SPAN



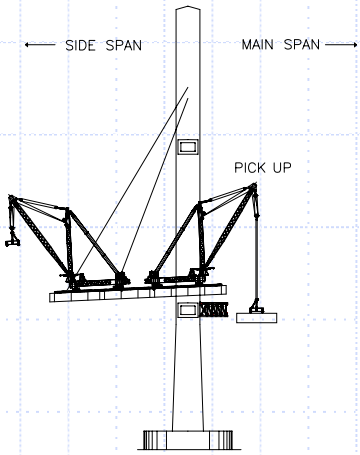
STEP13 : MOVE DERRICK CRANE OF SIDE SPAN



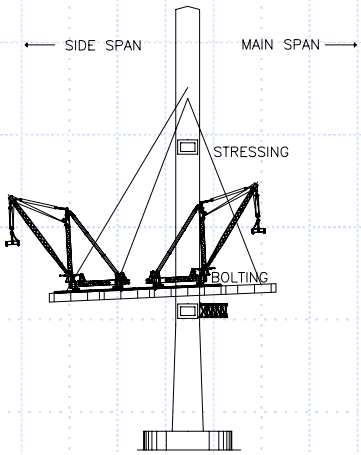

STEP14 : INSTALL DERRICK CRANE OF MAIN SPAN



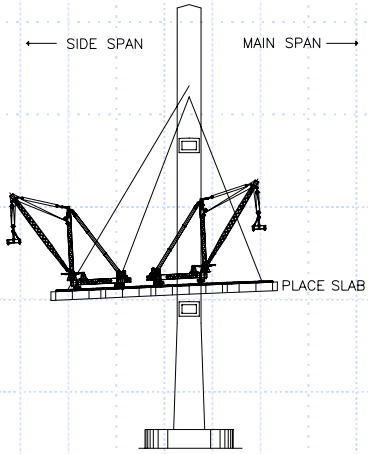

STEP15 : PICK UP STEEL GIRDER OF MAIN SPAN



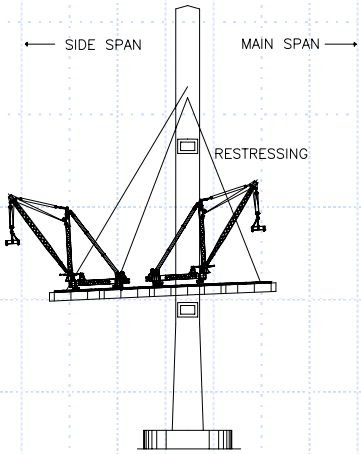

STEP16 : STRESS CABLE OF MAIN SPAN



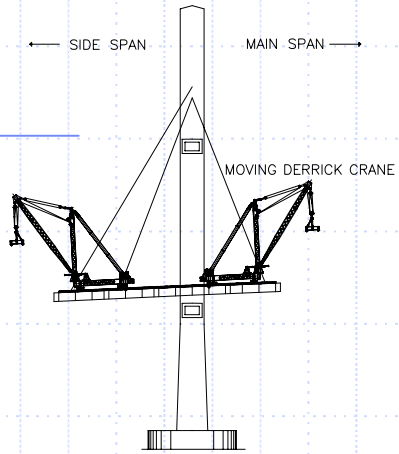

STEP17 : PLACE SLAB OF MAIN SPAN



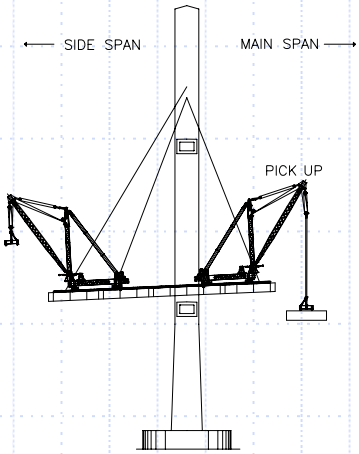

STEP18 : RESTRESS CABLE OF MAIN SPAN



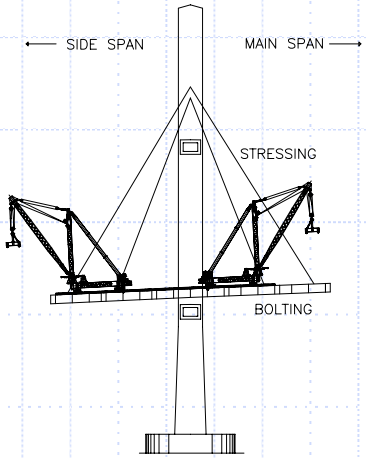
STEP19 : MOVE DERRICK CRANE OF MAIN SPAN



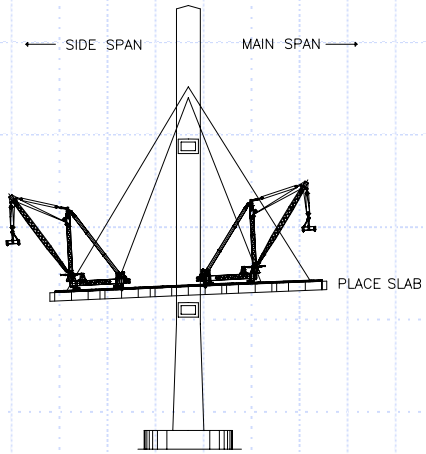

STEP20 : PICK UP STEEL GIRDER OF MAIN SPAN



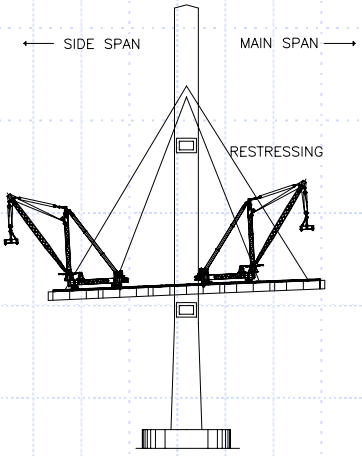

STEP21 : STRESS CABLE OF MAIN SPAN



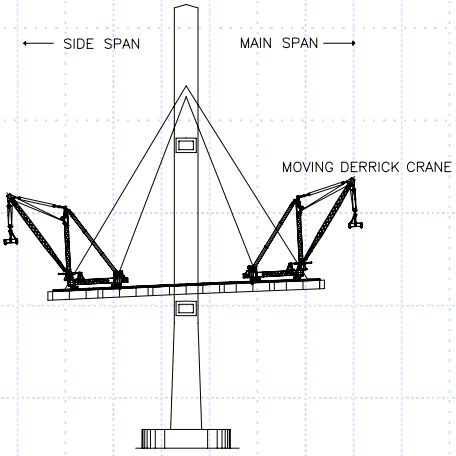

STEP22 : PLACE SLAB OF MAIN SPAN




STEP23 : RESTRESSING CABLE OF MAIN SPAN

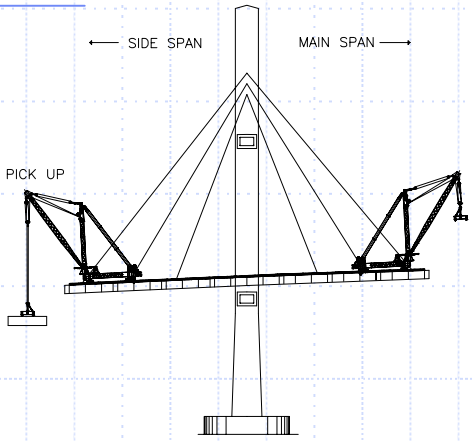



STEP24 : MOVE DERRICK CRANE OF MAIN SPAN

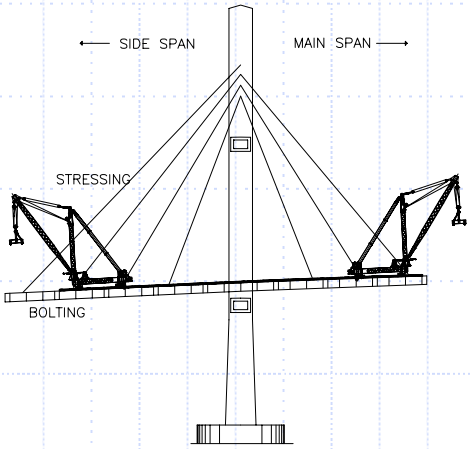


# 6.2 Typical 시공순서1

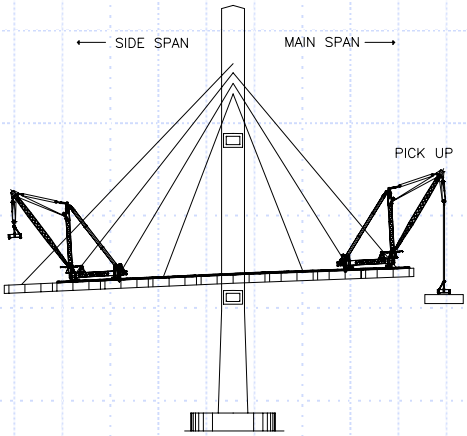
STEP1 : PICK UP STEEL GIRDER OF SIDE SPAN



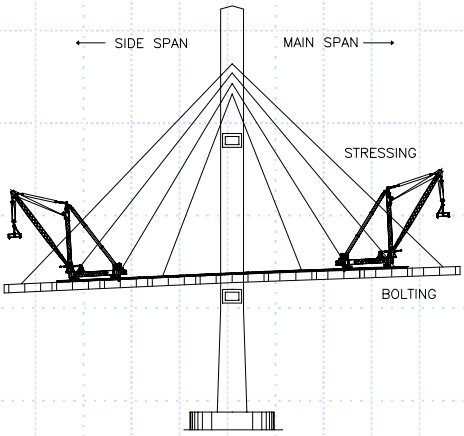

STEP2 : STRESS CABLE OF SIDE SPAN



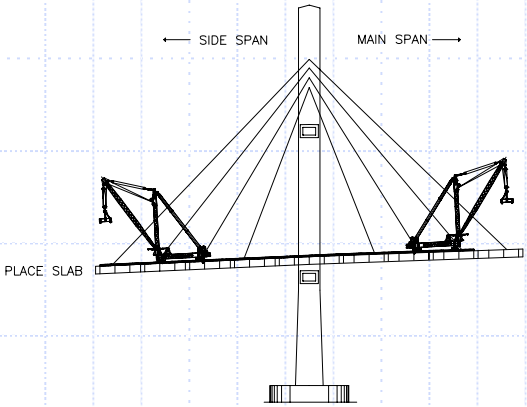

STEP3 : PICK UP STEEL GIRDER OF MAIN SPAN



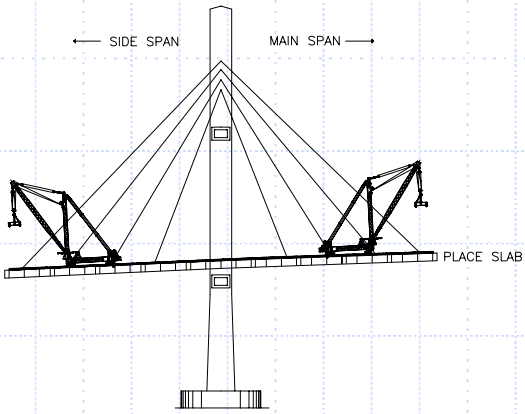

STEP4 : STRESS CABLE OF MAIN SPAN



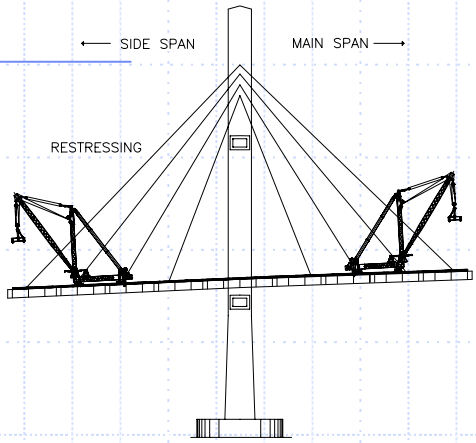

STEP5 : PLACE SLAB OF SIDE SPAN



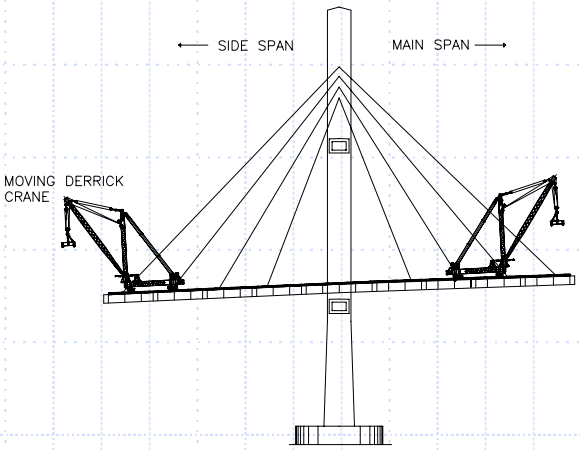

STEP6 : PLACE SLAB OF MAIN SPAN



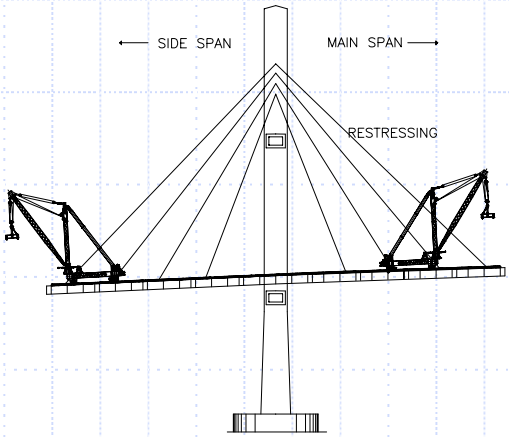
STEP7 : RESTRESSING CABLE OF SIDE SPAN



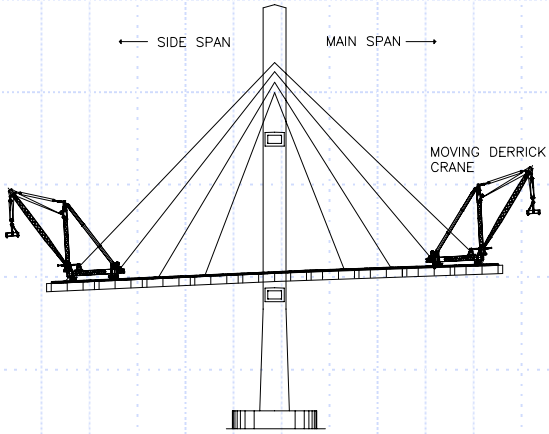

STEP8 : MOVE DERRICK CRANE OF SIDE SPAN



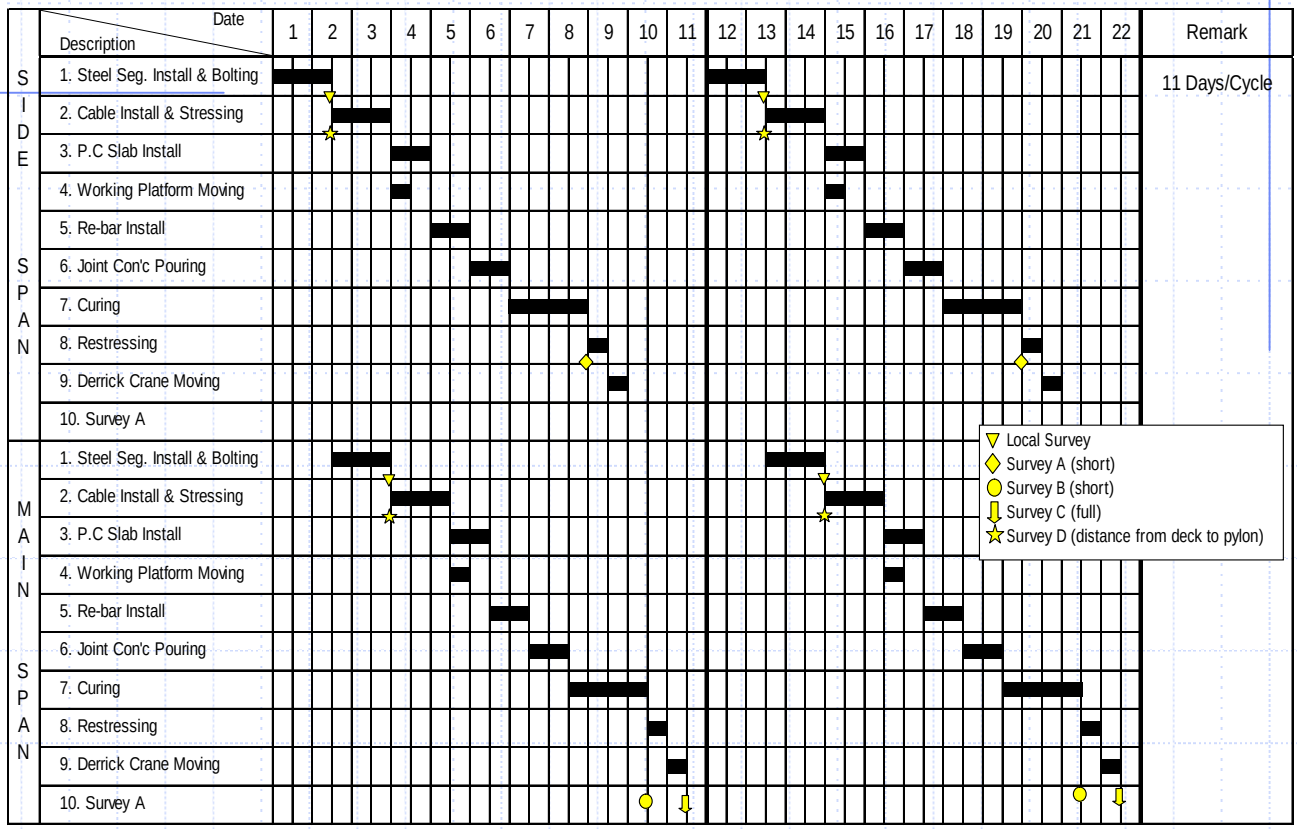

STEP9 : RESTRESSING CABLE OF MAIN SPAN



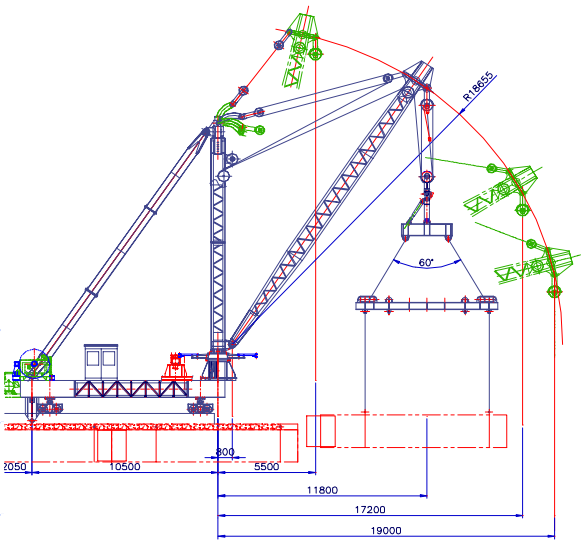

STEP10 : MOVE DERRICK CRANE OF MAIN SPAN



## 6.3 상부구조 시공 Cycle



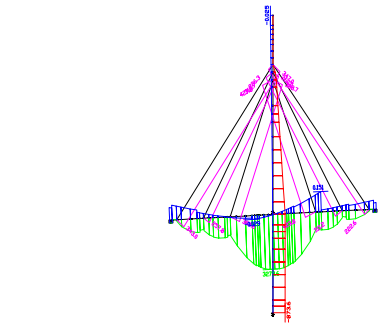

## 6.4 Derrick Crane (가설장비)

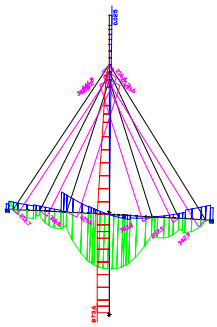


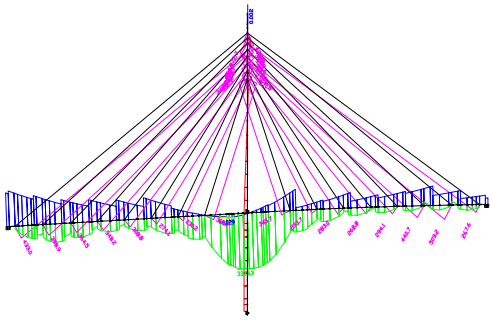

### SPECIFICATION

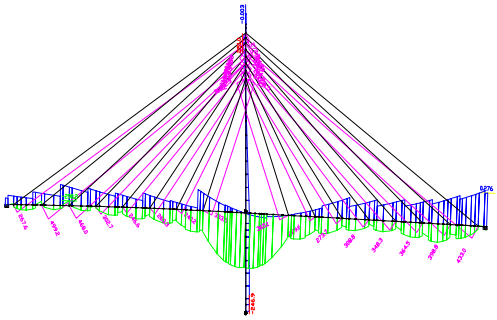
| 권상하중 | 70 Ton | 20 Ton | 5 Ton |
|---|---|---|---|
| 최대작업반경(m) | 11.8 | 17.2 | 19 |
| 최소작업반경(m) | 5.5 | 5.5 | 5.5 |
| 선회각도(°) | 0 | 90 | 240 |
| BOOM 길이 | 19.8 m | | |
| 권상속도 | UP 1 m/min DOWN 1.5 m/min | | |
| 기복속도 | 1.5 m/min | | |
| 선회속도 | 0.15 RPM | | |

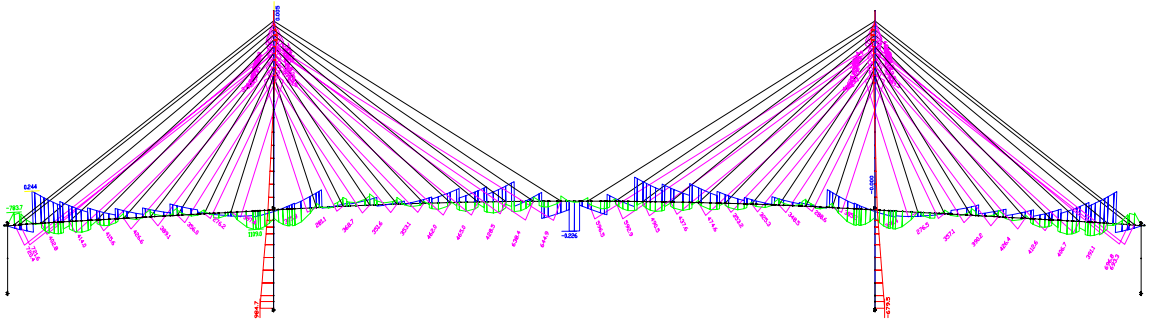
# 7. Stage Analysis 결과





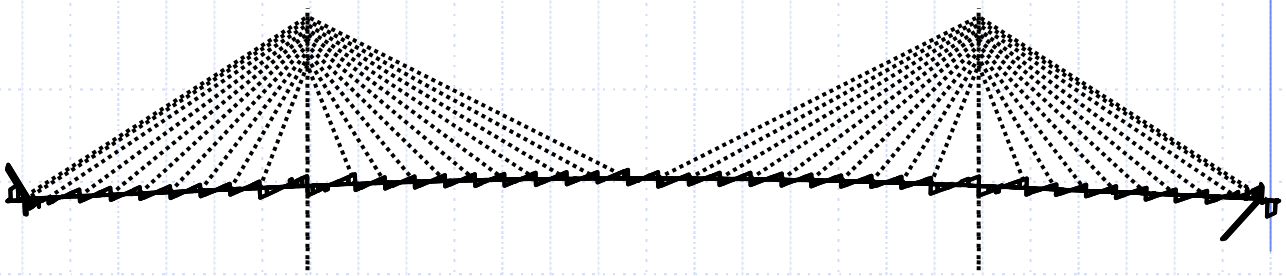




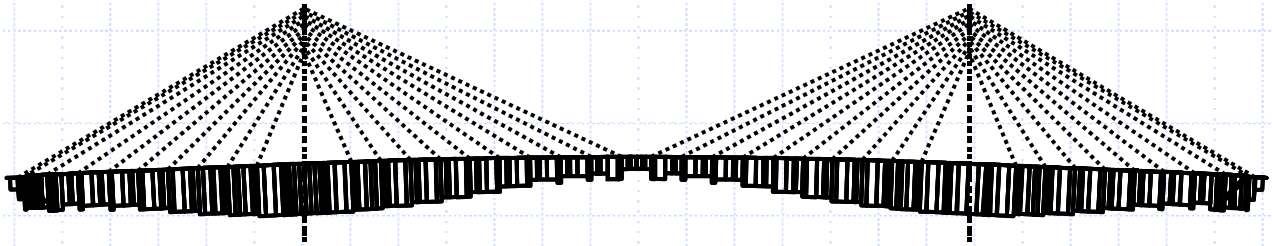


# 8. 해석결과

## 8.1 단면력도

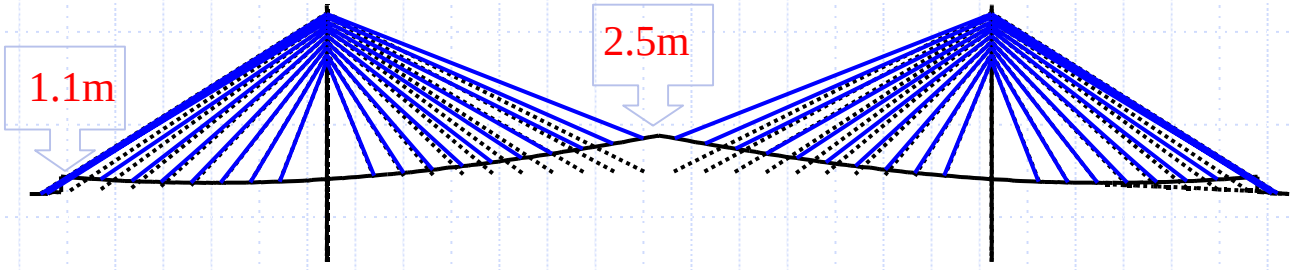


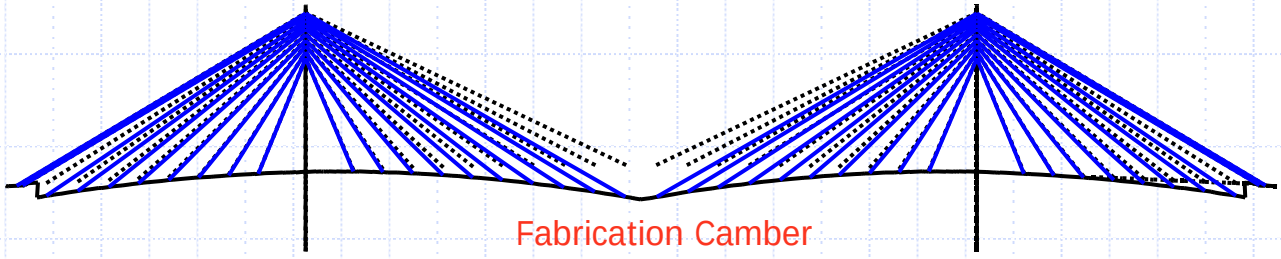
삼천포대교 최종 전단력도



삼천포대교 최종 축력도

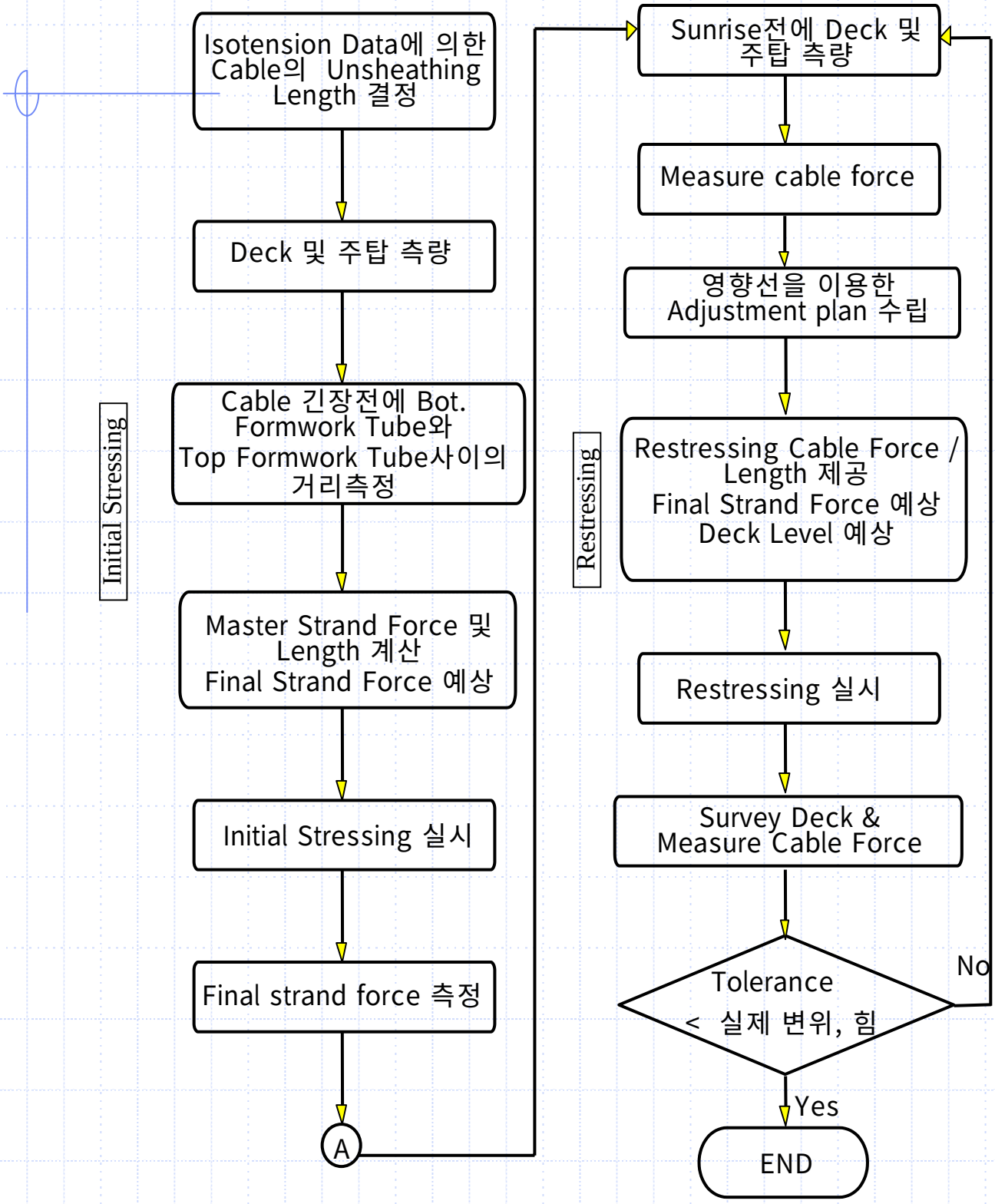
## 8.2 변위



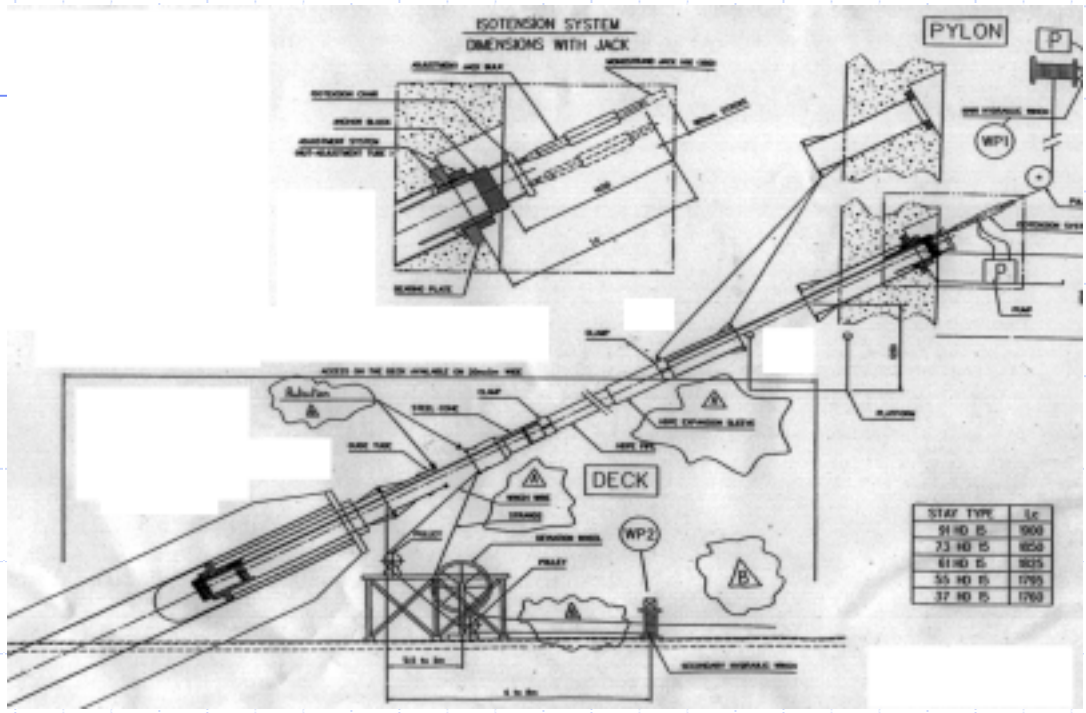



Fabrication Camber

# 9. Geometry Control

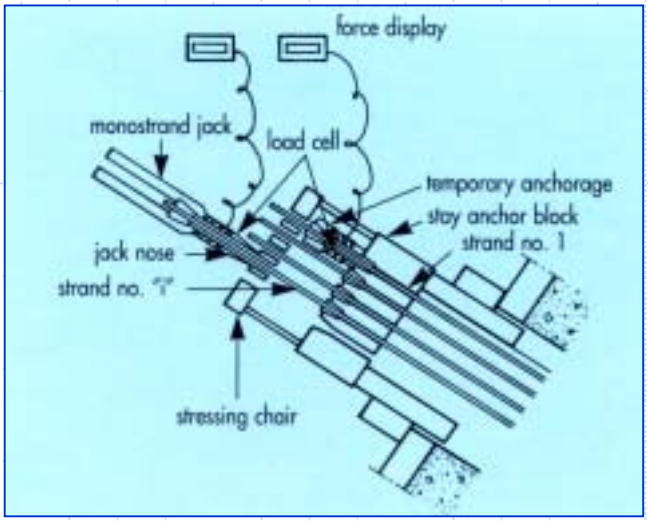


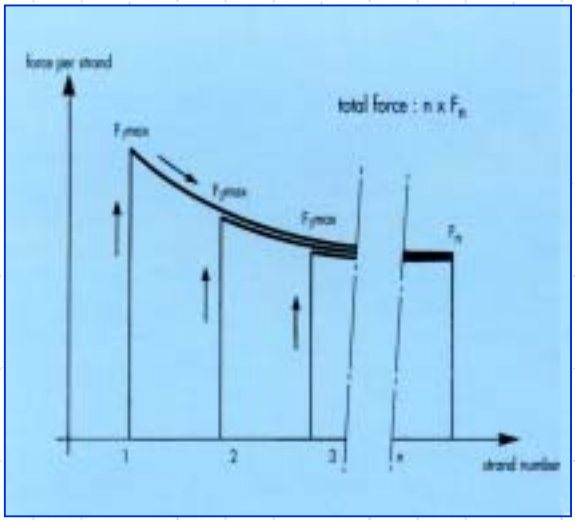
## 10. Strand by Strand 케이블 설치




## 11. Cable Stressing (or Restreesing) 방법

- **Multi Jack**을 사용한 인장방법
- **Mono Jack**을 사용한 방법 **- Isotensioning Method**

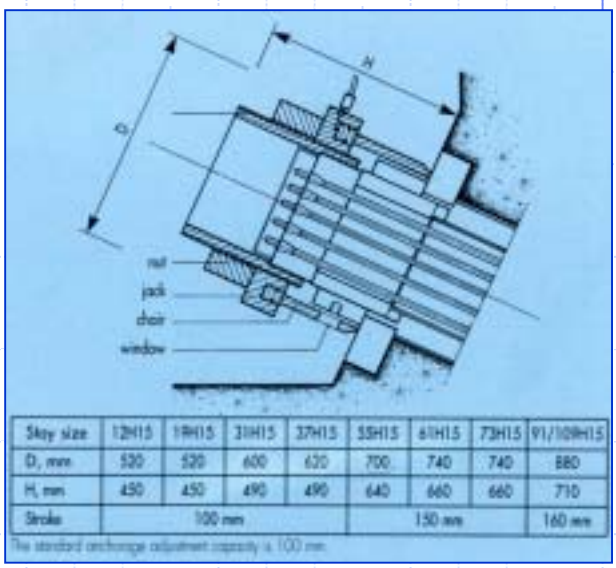


## 12. Isotension Method

## 13.Cable Destressing 방법

- **Donut Jack** 사용
  - **Anchorage Nut** 조정
  - **Shim Plate** 조정




| Strand size | 12H15 | 19H15 | 31H15 | 37H15 | 55H15 | 61H15 | 73H15 | 91/109H15 |
|---|---|---|---|---|---|---|---|---|
| D, mm | 520 | 520 | 600 | 620 | 700 | 740 | 740 | 880 |
| H, mm | 450 | 450 | 490 | 490 | 640 | 660 | 660 | 710 |
| Stroke | 100 mm | | | | 150 mm | | | 160 mm |

The standard anchorage adjustment capacity is 100 mm.

## 14. 시공현장 사진

### 14.1 프리캐스트 슬래브 제작

## 14.2 주두부 브라켓 설치

## 14.3 주두부 가설 1

## **14.4** 주두부 가설 **2**

## 14.5 데릭크레인 설치

## 14.6 강형 가설

주두부 강형 설치 **(L0)**

## 14.7 케이블 가설 - Working Platform 설치

## 14.8 정착구 설치

## 14.9 HDPE관 용접

## 14.10 HDPE관 인상

## 14.11 케이블 설치 및 인장

케이블 인장

## 14.12 프리캐스트 슬래브 설치

프리캐스트 슬래브 거치

죠인트 콘크리트 타설

## 14.13 Fixing Device