The Feasibility Study
on The Can Tho Bridge Construction in
Socialist Republic of Viet Nam

ANNEXURE 12

ADVANCE TECHNOLOGY FOR BRIDGE CONSTRUCTION

ADVANCED TECHNOLOGY FOR BRIDGE CONSTRUCTION (FOR TECHNOLOGY TRANSFER)

21st January 1998, Ho Chi Minh-City

ADVANCE TECHNOLOGY FOR BRIDGE CONSTRUCTION
(FOR TECHNOLOGY TRANSFER)

1. Advanced Technology for Bridge Construction in Japan

- PC Extra-dosed Bridge
- PC Hybrid Bridge

2. Construction Methods for Deep Foundation of Bridge

- Sinking Work Methods for Caisson Foundation
- Automatic Operation of Sinking Open Caisson Foundation

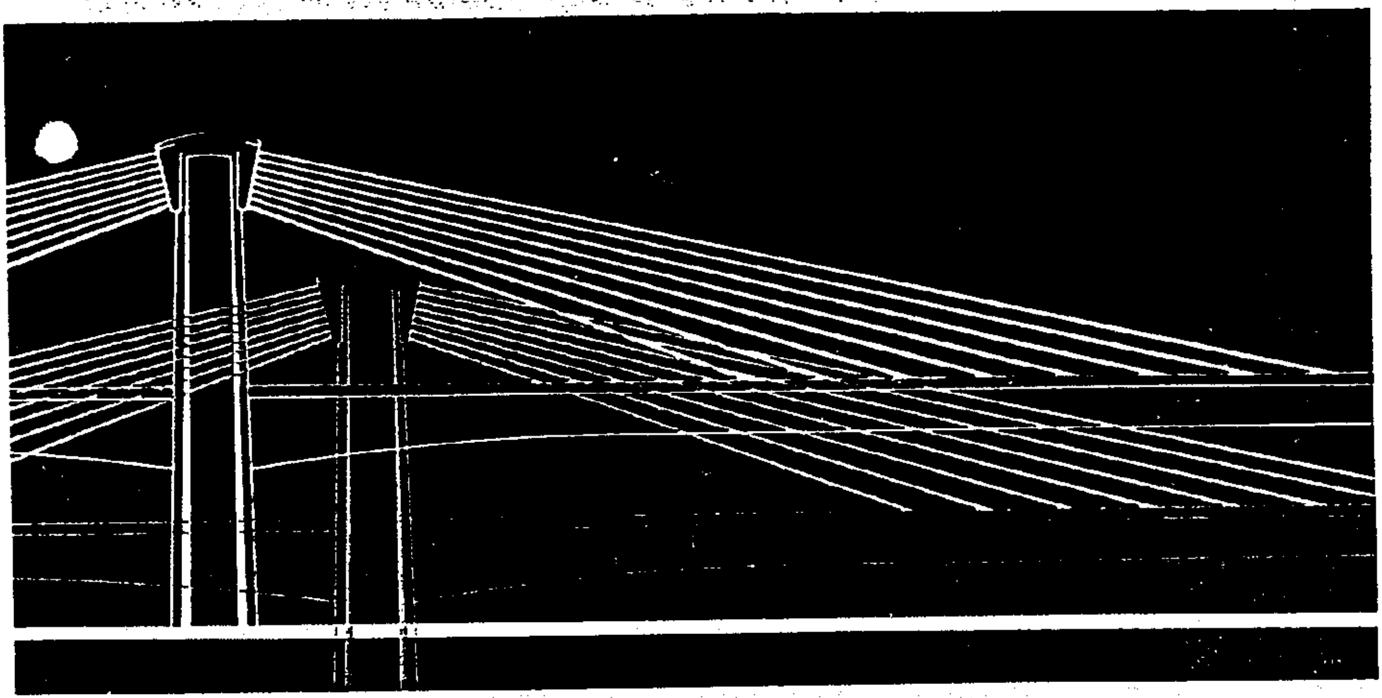
21st January 1998, Ho Chi Minh-City

1. Advanced Technology for Bridge Construction in Japan

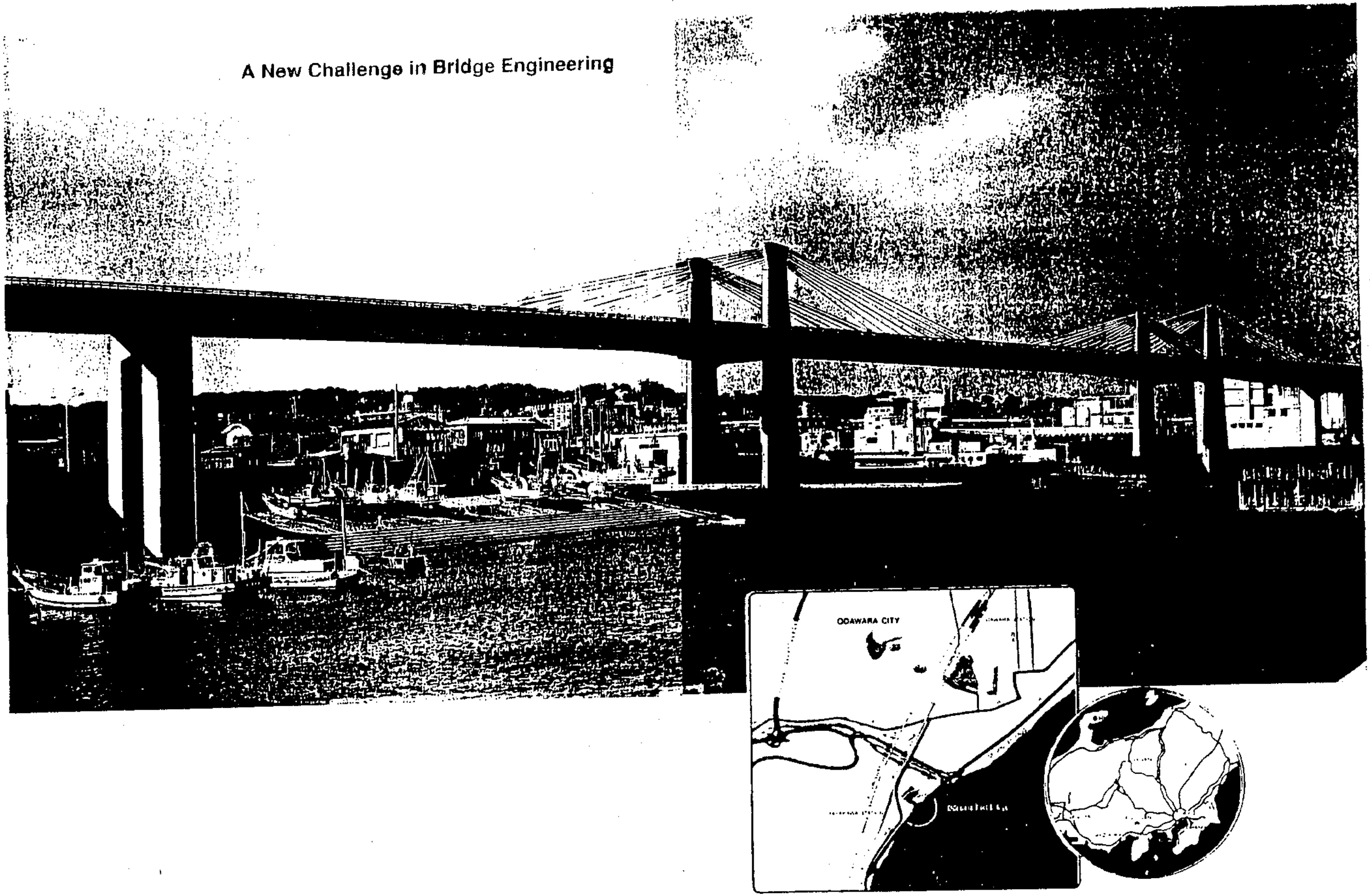
- PC Extra-dosed Bridge
- PC Hybrid Bridge

1. PC Extradoased Bridge

Odawara Port Bridge

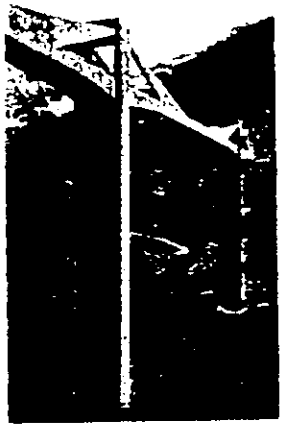


A New Challenge in Bridge Engineering



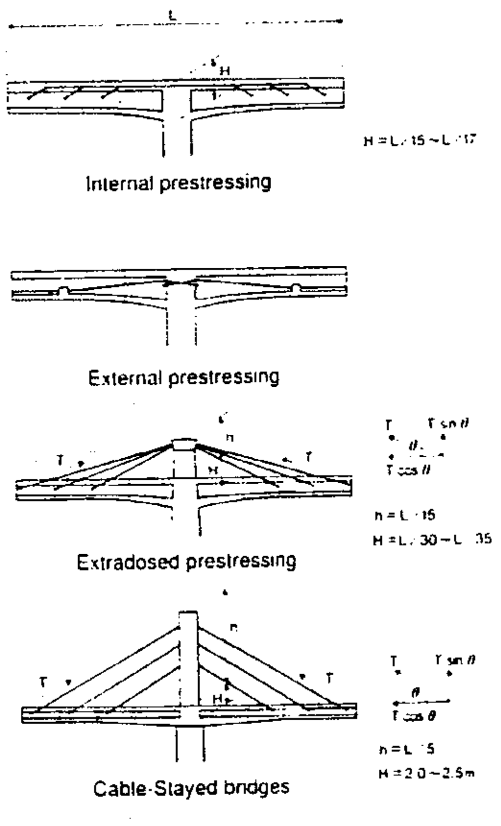
Extradosed prestressed bridges: the background

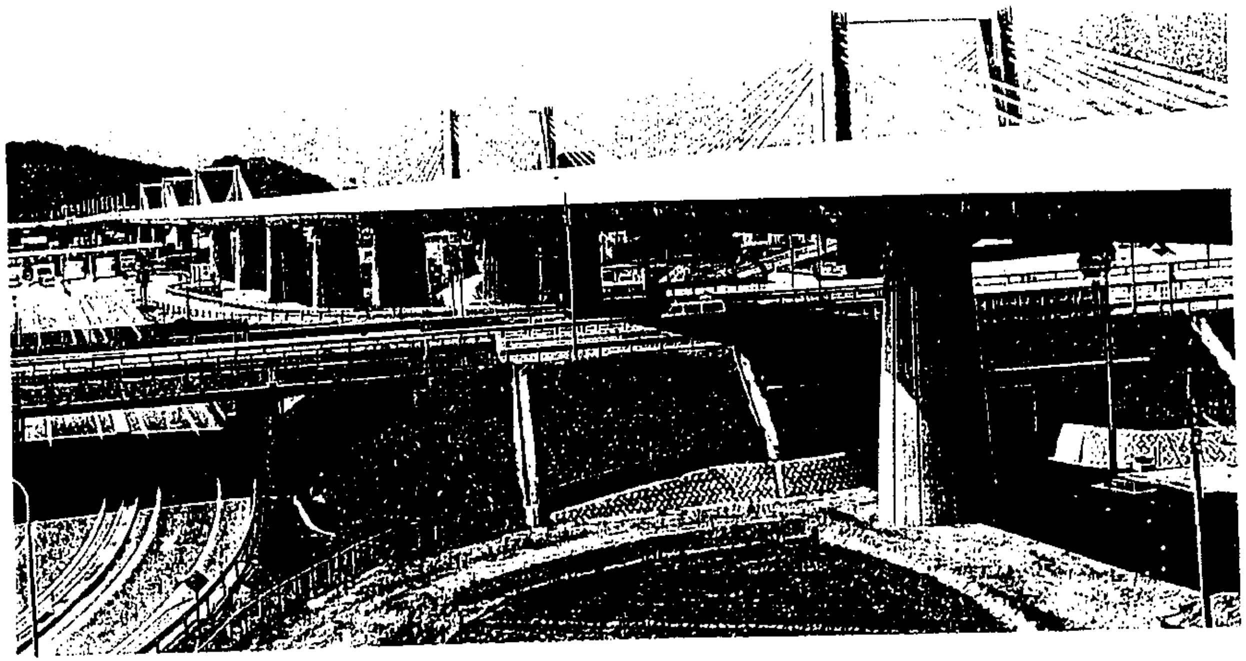
Gaunter bridge in Switzerland is the pioneer of extra-dosed type in the world. However, out cables were covered with concrete for anticorrosion of cable and concrete plate is expected to share bending moment of girder. This plate is effective just only for rigidity due to live load and super imposed load. And dead weight is increased.
Exposed out cable with anticorrosion casing are different type and more effective without dead load of concrete plate.
Blue way bridge of Odawara fishing bay in Japan in the first construction in the world.


Ganter Bridge

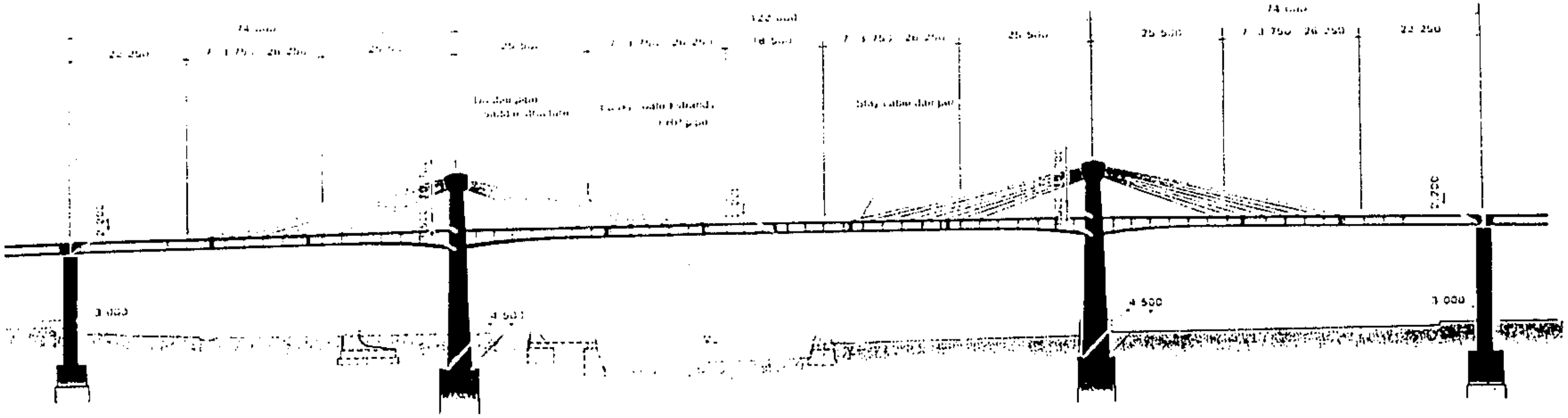

Barton Creek Bridge

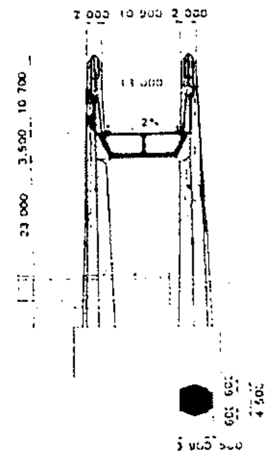
Conception of Extradosed Prestressing





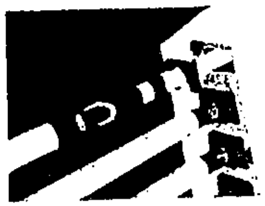
Extradoased Bridge for Railway in Japan



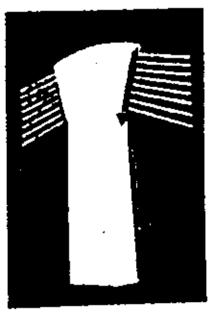


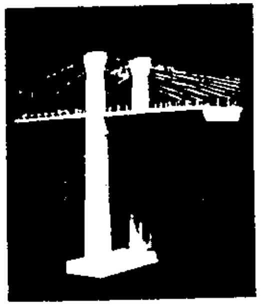
The Saddle Structure

In the Odawara Port Bridge, a saddle structure is adopted at the top of the tower. This is the first application in prestressed concrete bridges in Japan. The saddle has a double pipe structure, based on the design policy of allowing replacement of external cables. Stay cables are then anchored outside of the saddle in order to satisfy the requirement of not allowing them to slip, which would create a difference in cable force in the right and left sides. The validity of this design theory was first confirmed by testing on a full-scale model of the bridge, before being incorporated in the new bridge.



Saddle Anchorages

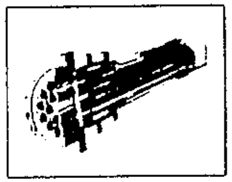




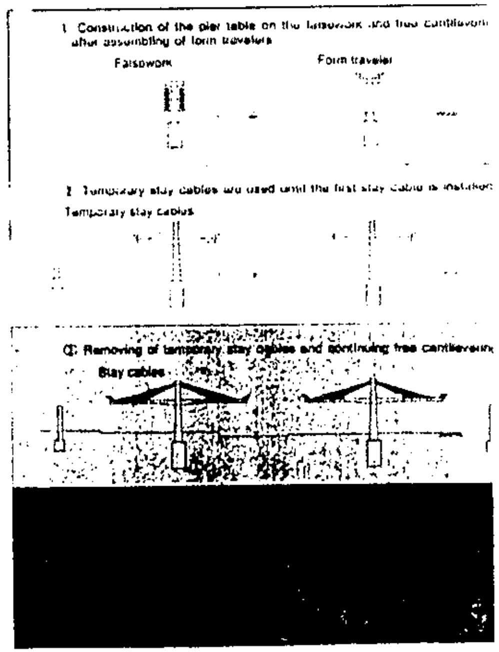
Full Scale Specimen

Stay Cables

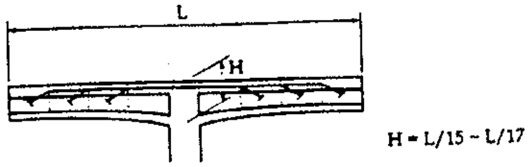
This is the first example in Japan of the adoption of epoxy coated strands (19ø15) as stay cables. Careful consideration has to be given to corrosion protection of the stay cables, owing to the coastal location of the Odawara Port Bridge. The triple protection afforded by epoxy coated strands, cement grout and FRP pipe guarantees durability. Since the cable stress change due to live load is a minor factor in extradosed prestressed bridges, the anchorages used are the normal ones, except for the double sheathing incorporated to allow replacement of stay cables. It is necessary to suppress stay cable vibrations because the allowable cable stress is only 0.6 tpu. Therefore, dampers were installed at the bottom of each stay cable, and polymer cement, which is amenable to elongation, was used for both corrosion protection and crack resistance. Testing was also carried out on the flexural fatigue of stay cables and the performance of the dampers, in order to confirm the validity of the safety factor allowed in the design for the stay cables.



Erection Sequence

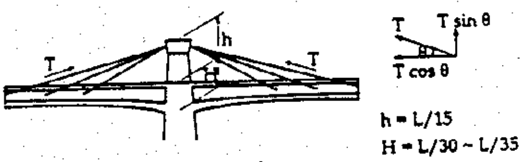


Conception of Extra-dosed Prestressing

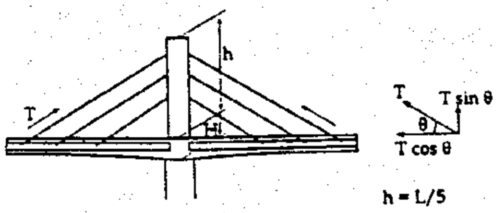


Internal prestressing

External prestressing



Extra-dosed prestressing



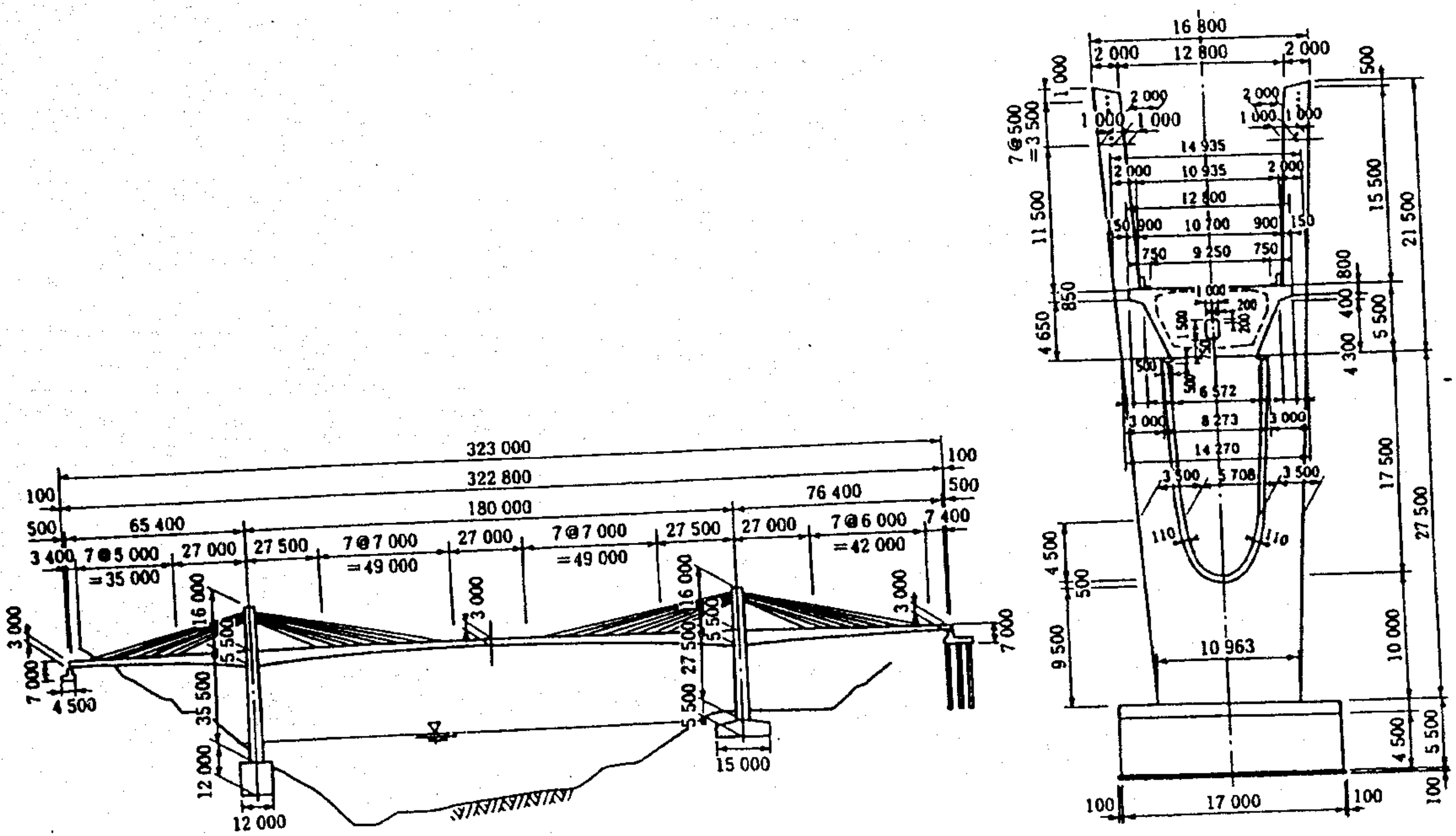
Cable-Stayed bridge

H = 2.0 ~ 2.5 m

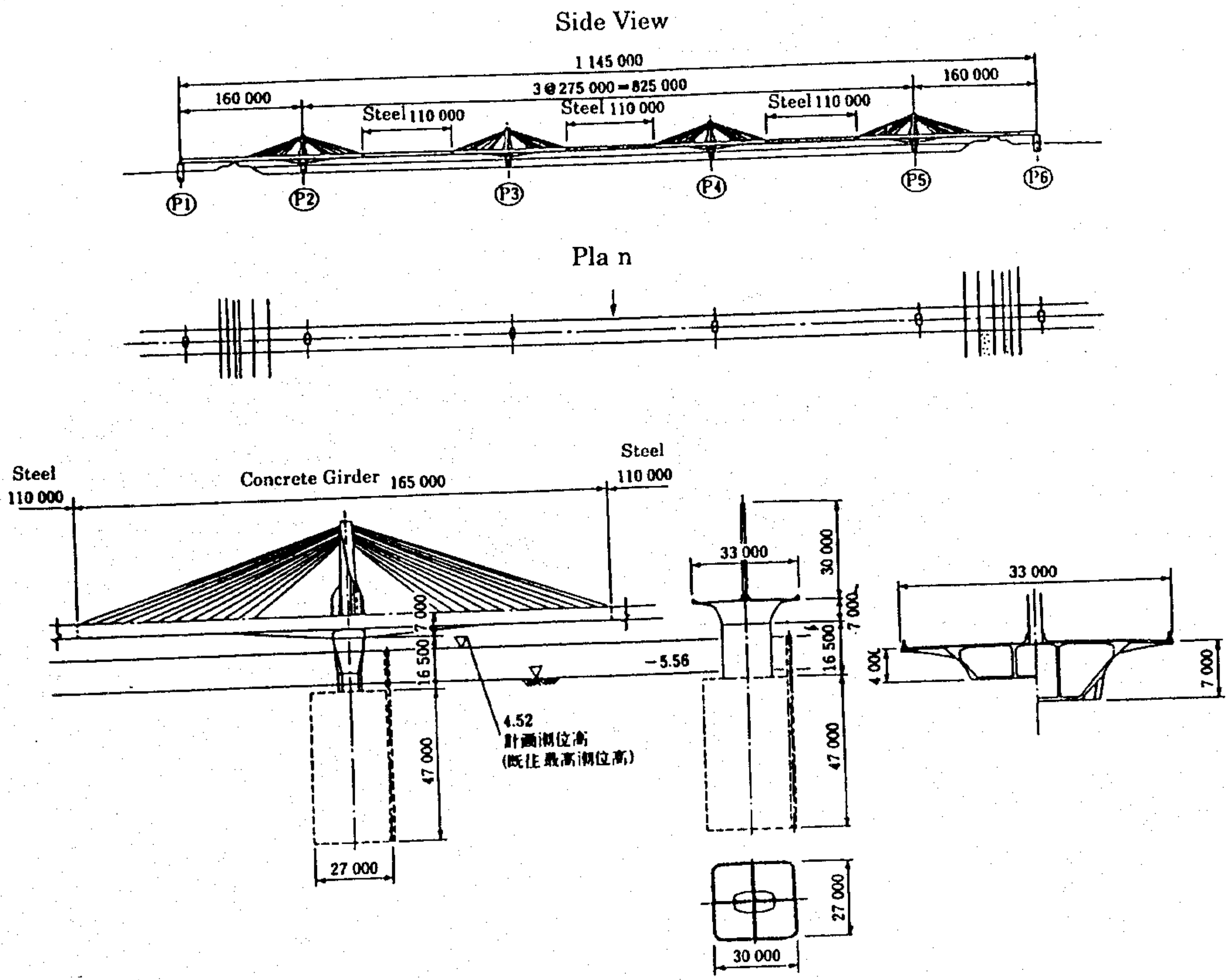
The above concept illustration show different feature for designing of Extra-dosed type, Cable-Stayed Bridge type and Girder type with internal prestressing and with external prestressing. Extra-dosed cable is one of external prestressing cable with large eccentricity for effective prestress against acting bending moment. And girder is more rigid and heavy than cable-stayed type, therefore $M_l/Md+M_l$ is less than that of cable-stayed type. Therefore, reduction of allowable stress of cable stay due to fatigue is less than that of cable-stayed type. Then, allowable stress of stay cable of both types are used as follows;

for cable-stayed bridge: $\sigma pa = 0.4\ \sigma pu$
for extra-dosed bridge: $\sigma pa = 0.6\ \sigma pu$

Stay cable or extra-dosed type is more effective than cable-stayed type. Then, amount of stay cable to be required for extra-dosed is less than cable stayed type. Stay cable with anchorage device and anticorrosion sheath is very much expensive. saving amount of stay cable contribute to eliminate construction cost. Therefore, extra-dosed type bridge is more economical than cable-stayed type.



General View of Tsukuhara Bridge



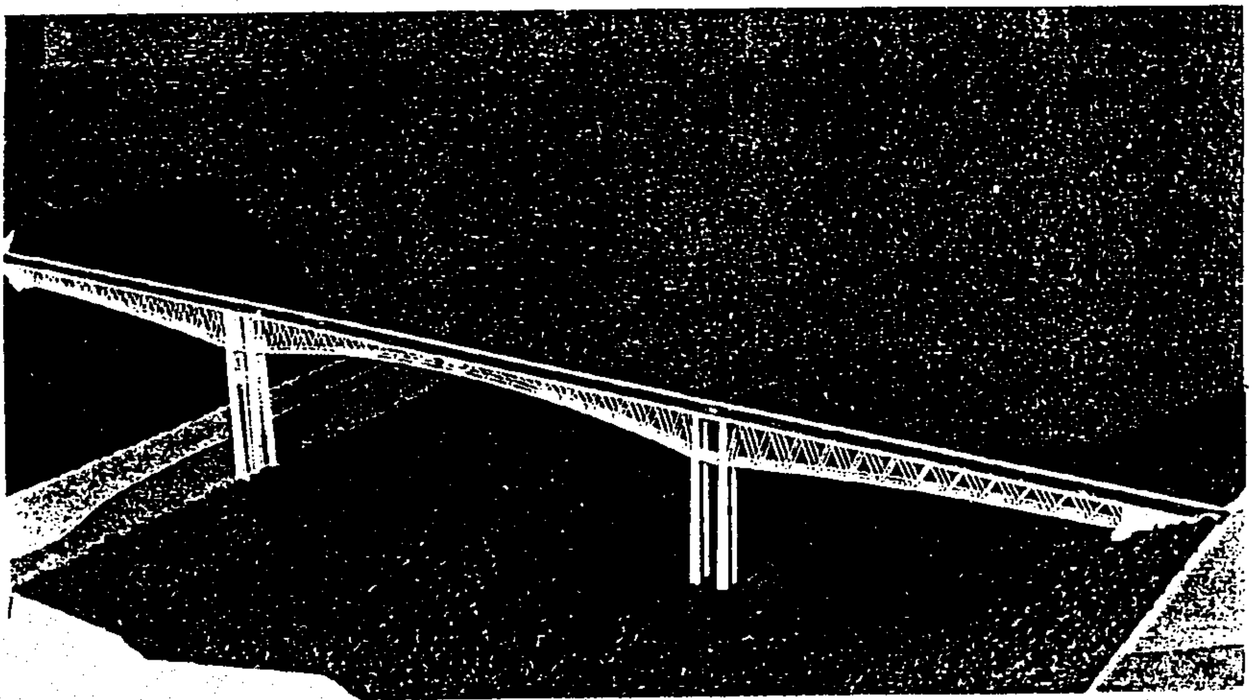
General View of Kiso Gawa Bridge

2. PC Hybrid Bridge

NEW PROPOSAL OF PC HYBRID TRUSS

Contributing to Eliminate Construction Cost by Decreasing the Weight of Superstructure

1. Outline of the Structural System and its Aim
2. Merit of the Structure
3. Applicable Range and Method
4. Applied Records in the Past
5. Feasibility
6. Further Theme to be Solved



1. OUTLINE OF THE STRUCTURAL SYSTEM AND ITS AIM

* Hybrid Truss

The Hybrid Truss is to utilize each advantageous characteristics of concrete and steel, and to suppliment characteristic disadvantage of each materials.

[Concrete]	[Steel]
* Cheap Material *Heavy Load *Strong in Compression, Weak in Tension	*Expensive Material *Light Load *Strong in Tension, in Buckling

* Basic Concept

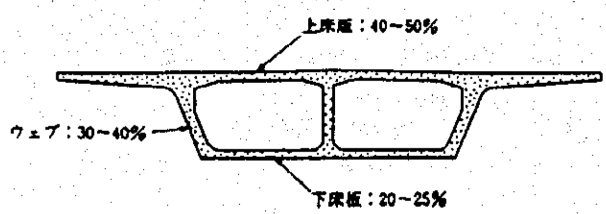
*Sectional Proportion of Ordinary PC Box Girders

Upper Slab	:	40~50 %
Web	:	30~40 %
Lower Slab	:	20~25 %

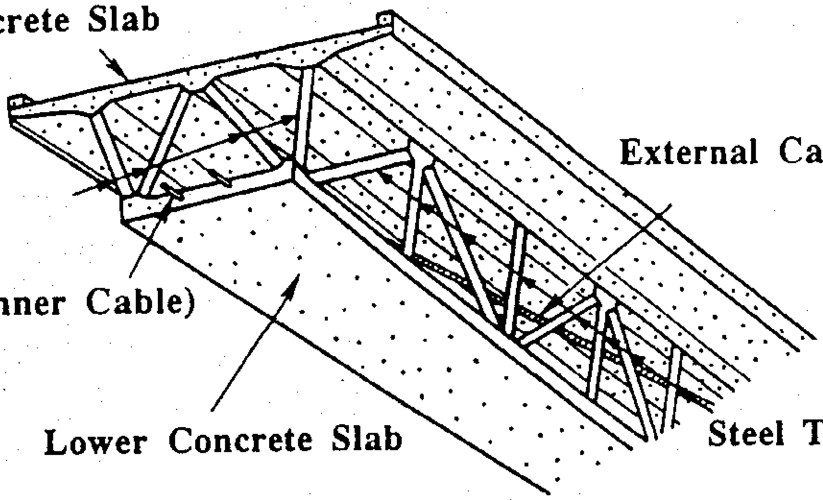
*The Aim of Hybrid Truss is to Reduce Total Weight of Girder replacing Concrete Web by Steel Truss.

Concrete Web--->Steel Web--->Light Girder

*Ordinary PC Cables in Concrete Web are to be Accomodated in Space between Upper and Lower Slabs as Out Side Cables---> Utilization of External Cables.



*Structural Profile



*Upper Slab	: Concrete Structure
*Lower Slab	: Concrete Structure
*Web	: Steel Truss

*Accomodation of PC Tendon

Upper Slab/ Lower Slab : Inner Cable

Out of Concrete Section : External Cable

*Necessity of Hybrid PC Truss

[Background of Nowadays Construction Industry] / [Needs]

1. To be Cheap : Reduction of Construction Cost
2. Safe to Earth Quake : Improvement of Seismical Safety
3. Good Appearance : Harmony with Environment
4. Easy to Construct : Labour/ Manpower -Saving
5. Long Structure Life : High Durability
6. Free Maintenance : Minimum Maintenance

↓

Better Solution of [Needs] for Bridge Structural System:
PC Hybrid Structural System

2. MERIT OF THE STRUCTURE

*Advantage of This Stractural System

1. Reduction of Superstructure Dead Load
2. Reduction of Construction Cost
3. Improvement of Seismical Safety
4. Harmony with Environment
5. Labour/ Manpower -Saving
6. Minimum Maintenance

*Comparison with Various Structure System

Item / Bridge Type	Applicable Span	Economical Merit	Aseismicity	Aesthetics	Maintenance
PC Box Girder	50~150m	○	○	○	○
RC Rigid Frame	50~250m	○	○	○	○
Steel Truss	50~350m	□	○	□	□
PC Cable Stayed	100~350m	□	○	○	○
PC Hybrid Truss -Continuous Girder -Rigid Frame	 50~350m 50~450m	 ● ●	 ○ ○	 ○ ○	 ○ ○

Remarks:

● : More Advantageous than ○
□ : Less Advantageous than ○

*DETAILED TECHNICAL FACTORS TO PROVIDE MERITS

① Lighter Load

*Lightening of Superstructure Dead Load--->Reduction of Earthquake Force--->Reduction of Substructure Dimensions---> Cost Saving

② Seismic Stability

*Lightening of Superstructure Dead Load--->Flexible Structure/Long Natural Period--->Reduction of Earthquake Effect
*Continuation of Superstructure--->Grading up Degree of Redundancy--->Increasing Reduntant Strenth

③ Harmony of Surrounding Environment

*Smart Structure--->Creation of Aesthtic View--->Harmonized Environmental Impact

④ Labour/Manpower Saving

*Employment Prefabricated/Precast Members--->Reduction of Field Works--->Labour Saving--->Reduction of Construction Period

⑤ High Strtuctural Durability

*Employment Highly Strengthed Precasted Concrete--->Leveling up the Structural Quality

⑥ Minimum Maintenance

*Reduction of Repainting Works--->Reduction of Maintenance Cost

3. POSIBILITY TO APPLY THE HYBRID TRUSS BRIDGE

*Possible Span Ranges as a Part of Various Bridge Type

① Simple Girder Bridge	:	30~50m
② Continuous Girder Bridge	:	40~150m
③ Continuous Rigid Frame	:	60~250m
④ Cable Stayed Bridge	:	150~400m

*Possible Structural Type for Various Structural Porpose

① Viauct Type Structure
:Malti Span Continuous Girder (40m of span length)

② Flyover Type Structure
:Continuous Girder

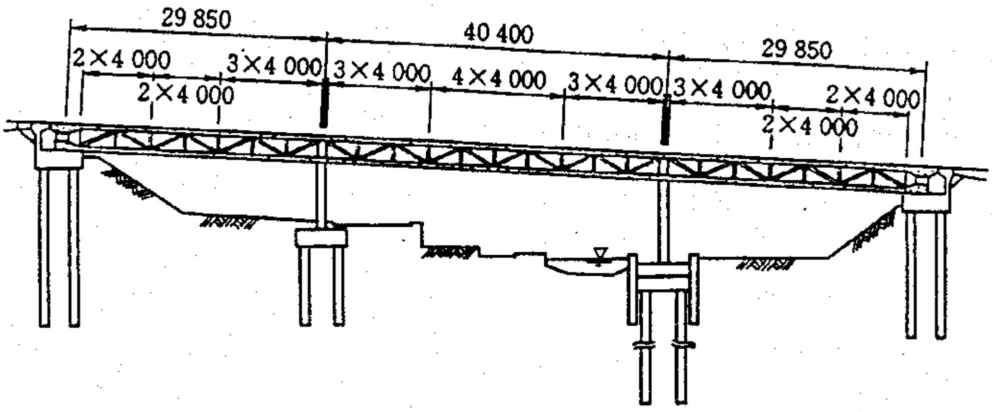
③ River Crossing Brige
:Continuous Girder

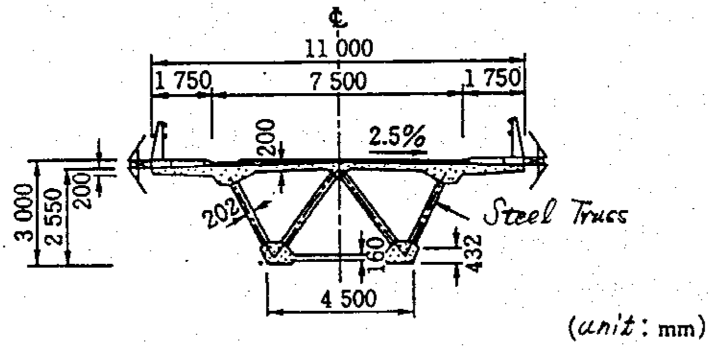
④ Long Spanned Bridge
:Continuous Rigid Frame Bridge, or Cable Stayed Bridge

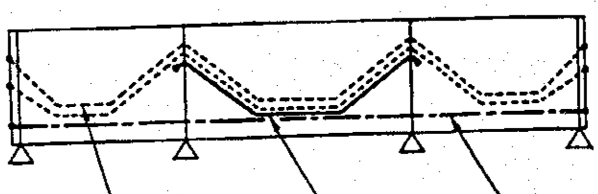
4. ALREADY BUILT BRIDGES WITH HIBRID TRUSS TYPE

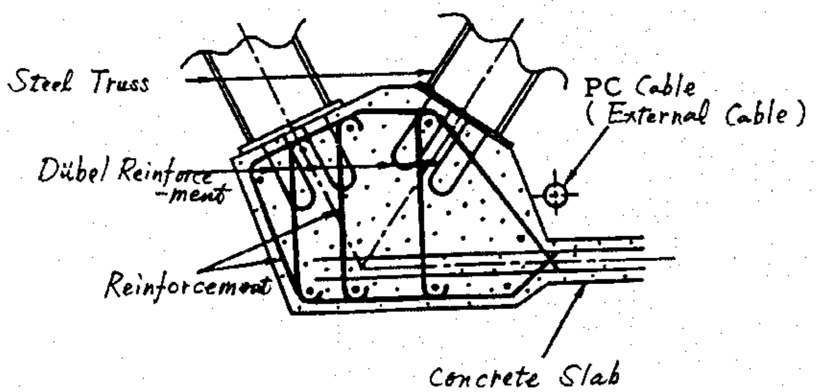
* In Overseas

Albaron Bridge in France 1984

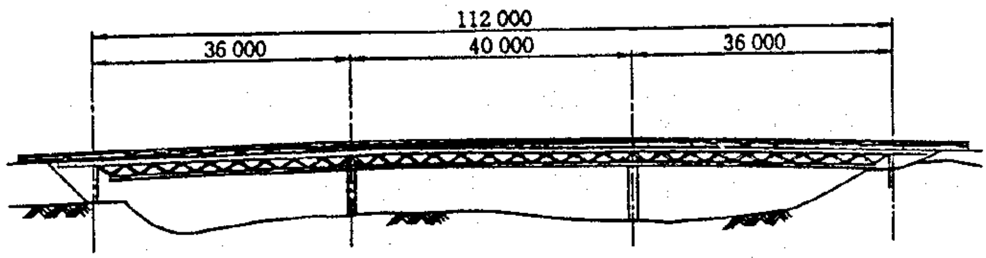


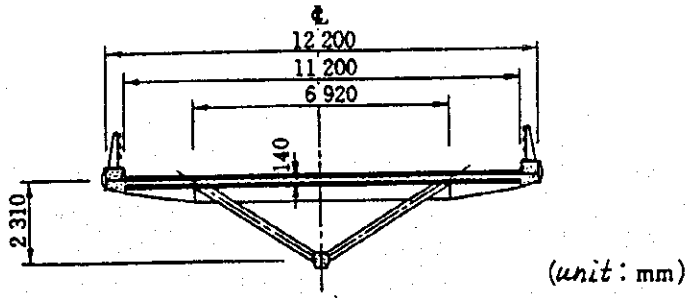


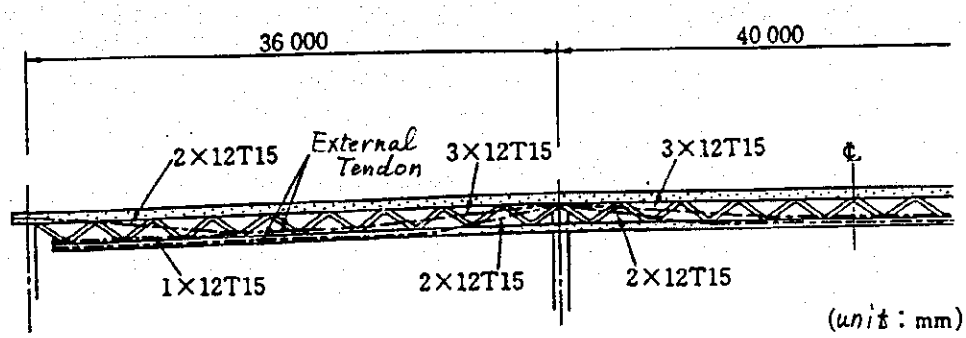


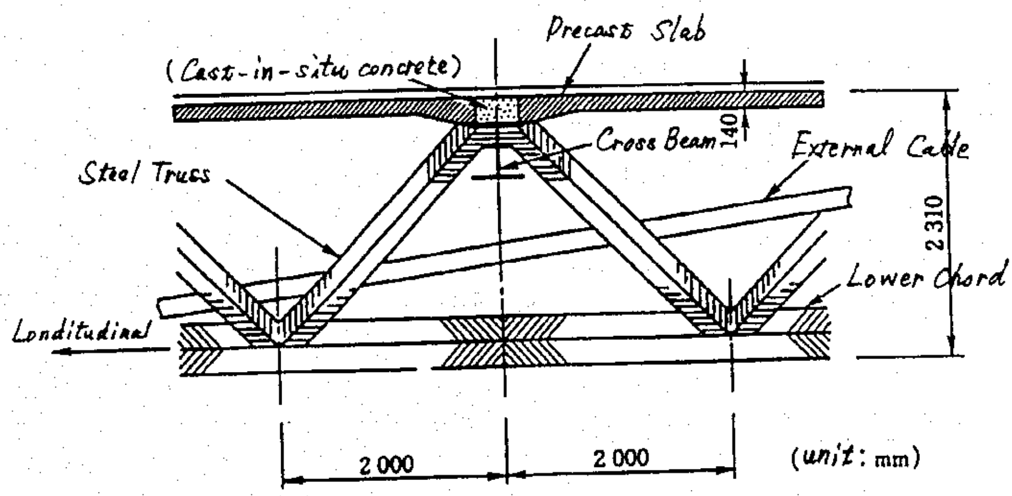


La Roize Bridge in France









*Under the Plan in 1995

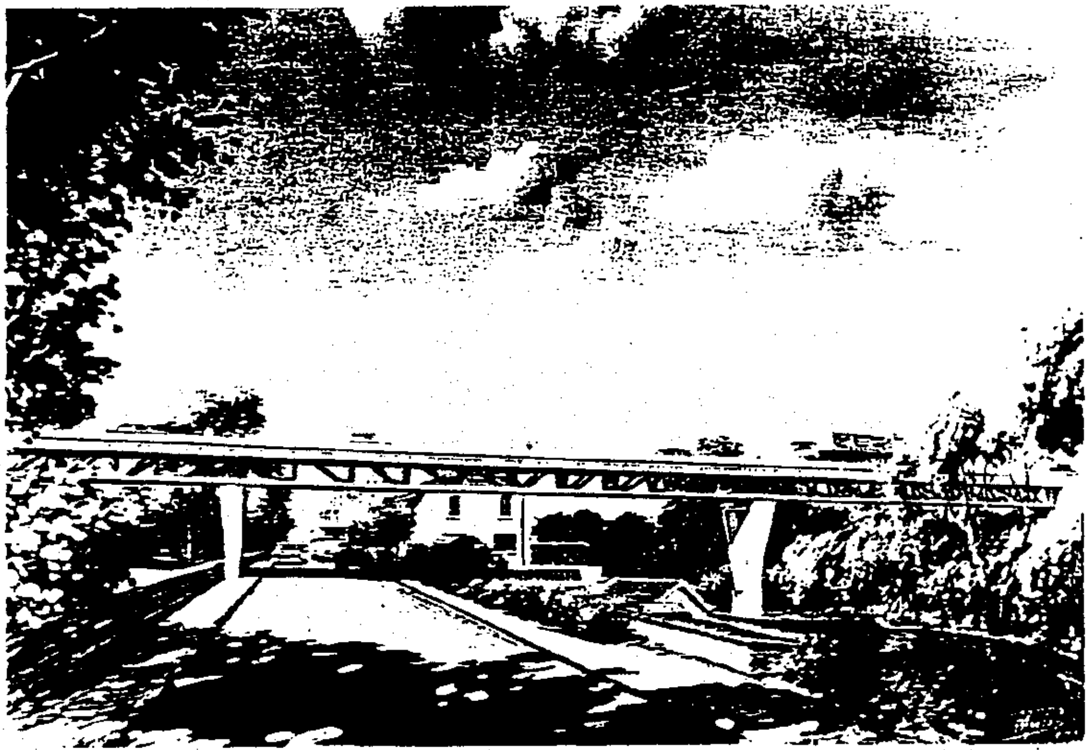
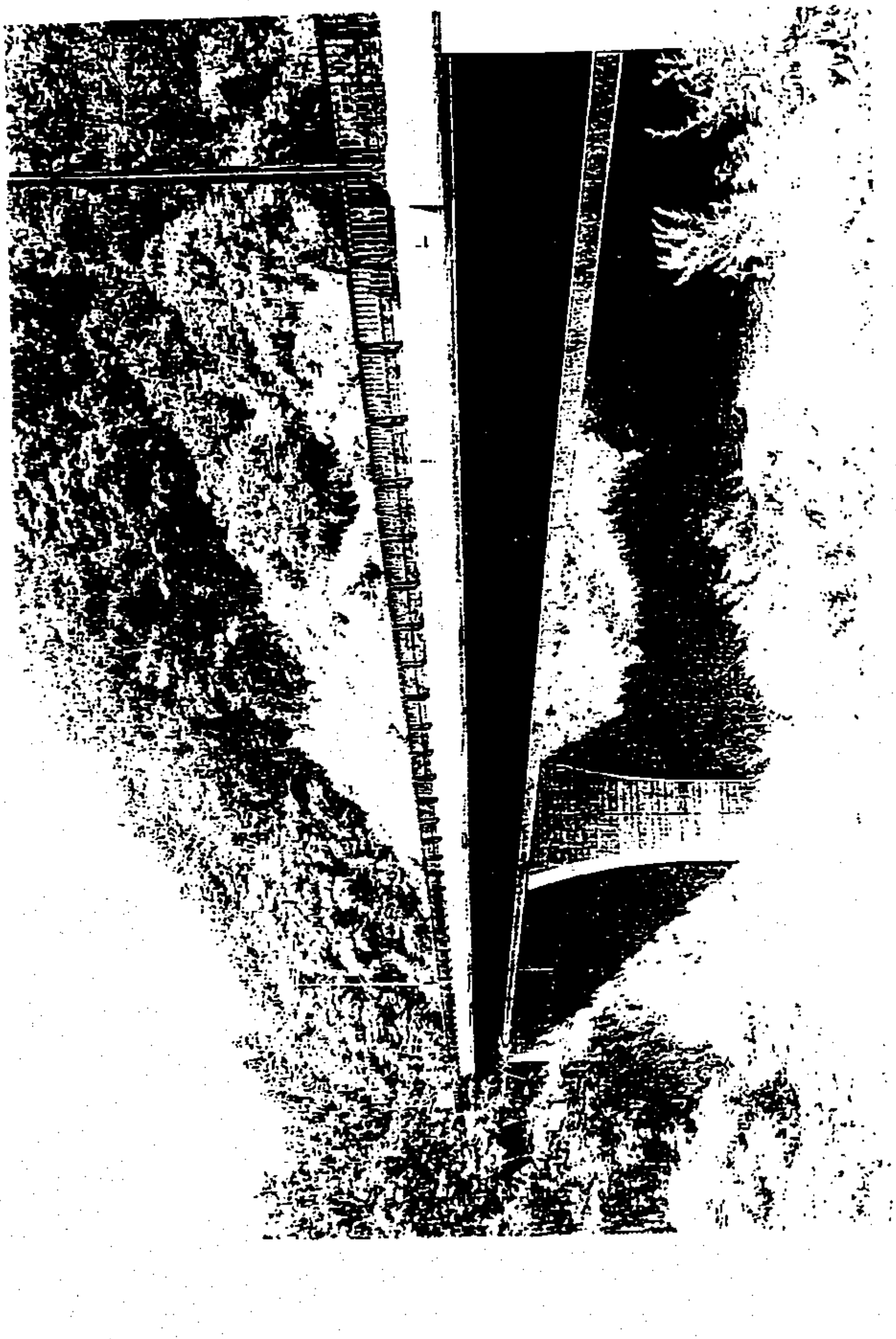


Photo 13: Un projet de pont avec des âmes métalliques planes triangulées, proposé par les entreprises S G E et D T P (D T P).

Photo 13: Proposal for a bridge with triangulated flat steel webs put forward by the firms S G E and D T P (D T P).

*<u>In Japan</u>

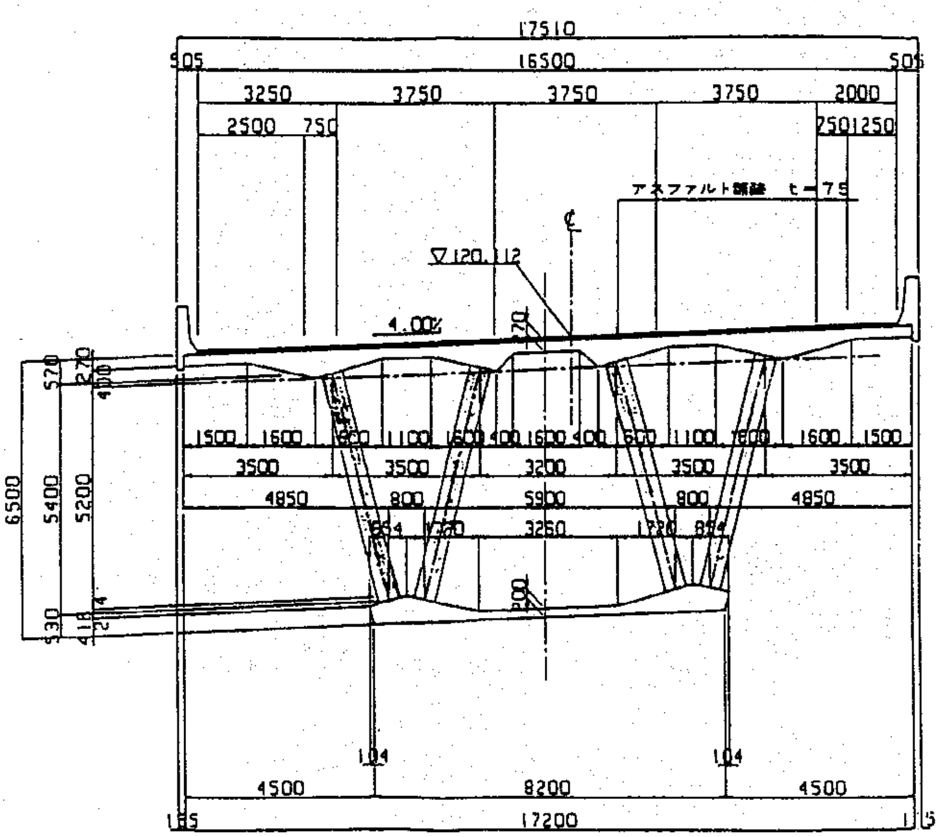
Matsunoki Bridge : PC Box Girder Steel Deck Plate for Web in 1995



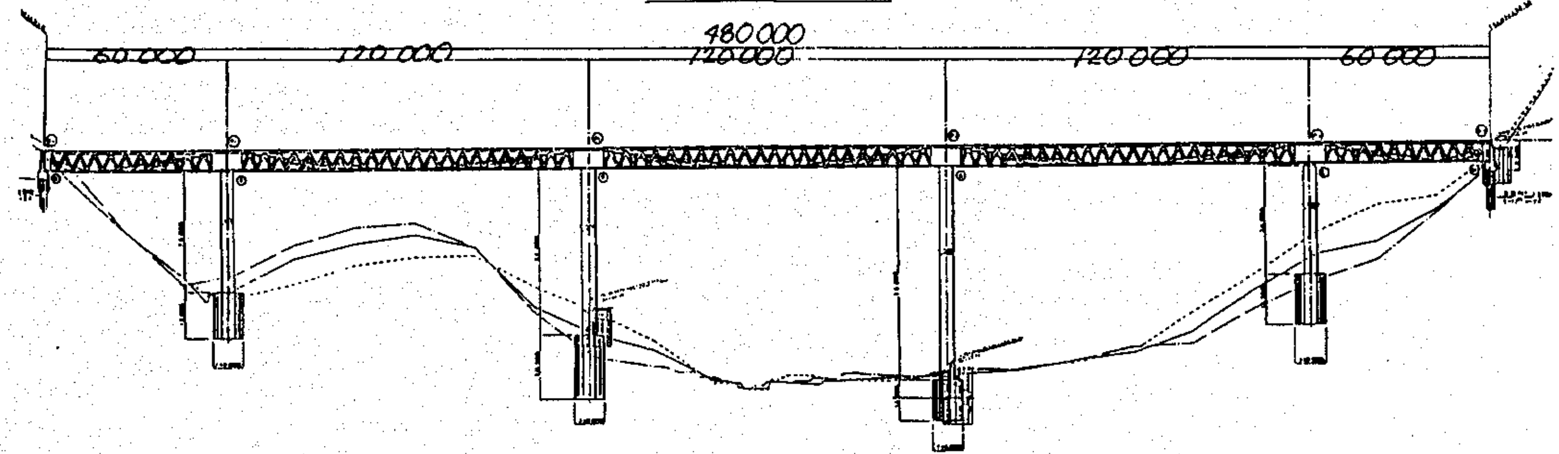
Tomoe River Bridge in Second Tokyo-Nagoya Expressway under the Construction

Type: 5 Continuous Span Truss Girder
Length: 60+120@3+60=480m

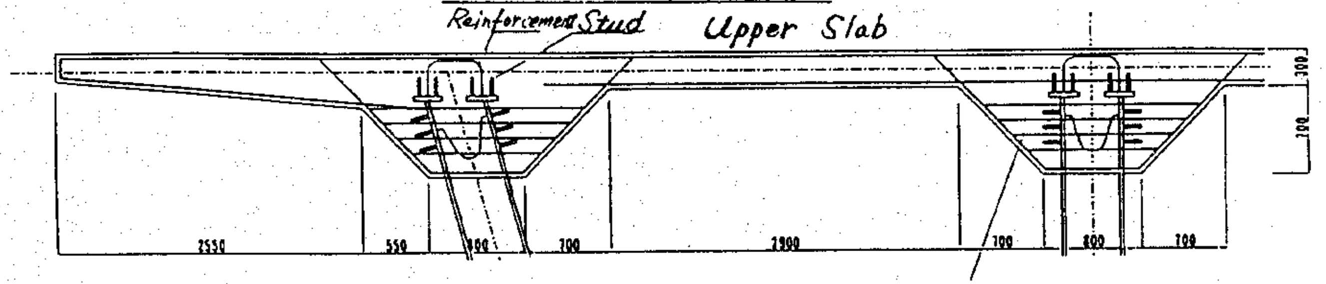
Cross Section of Center Span

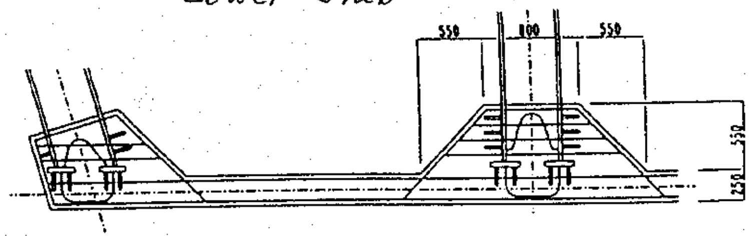


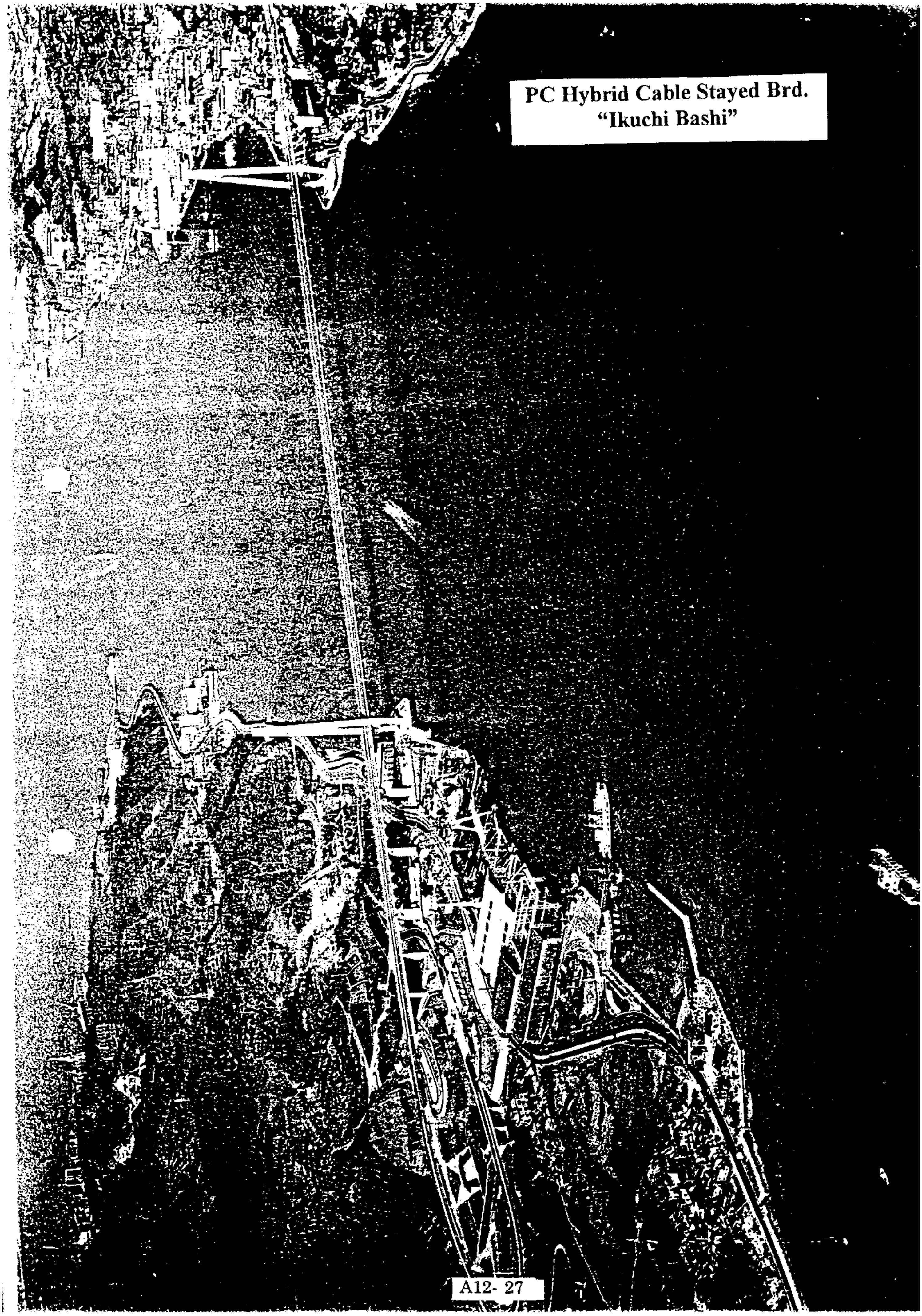
PROFILE



Connection of Slab







PC Hybrid Cable Stayed Brd.
"Ikuchi Bashi"

5. FEASIBILITY OF LONG SPAN BRIDGE

*Case Study of Long Span Bridge

Comparative Study of 3-Span Long Continuous Bridges

Bridge Length	Bridge Width
Type A: 140+180+140=460m	16.4m(15.0m)
Type B: 172+240+172=584m	20.2m(17.0m)
Type C: 260+380+260=900m	20.2m(17.0m)

*Structural Concept

-Structural System

Upper/ Lower Slab: Precast PC Member
Web with Truss : Steel Box Member

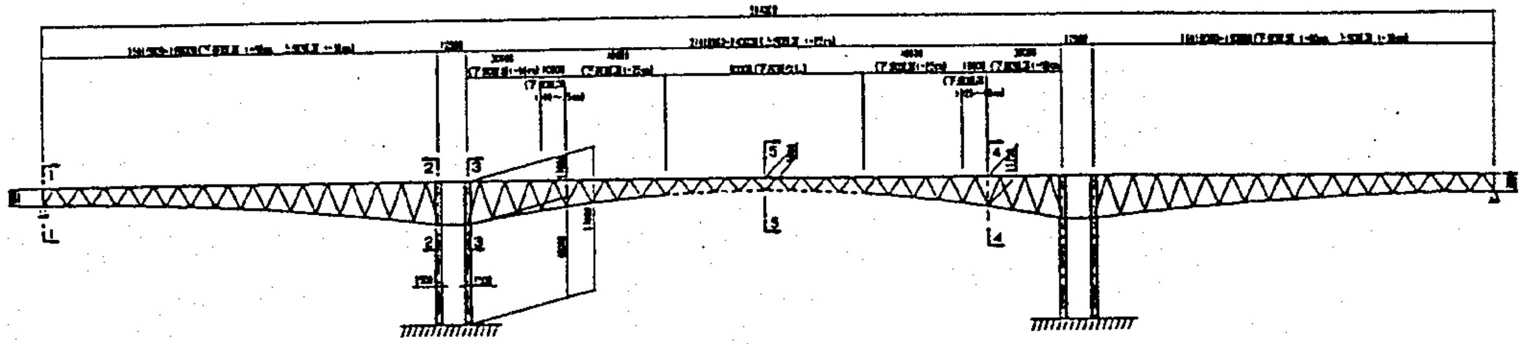
-Quality of Materials

PC Slab Plate : σ_{ck} = 550 kgf/cm^2
Truss Member : SM 570

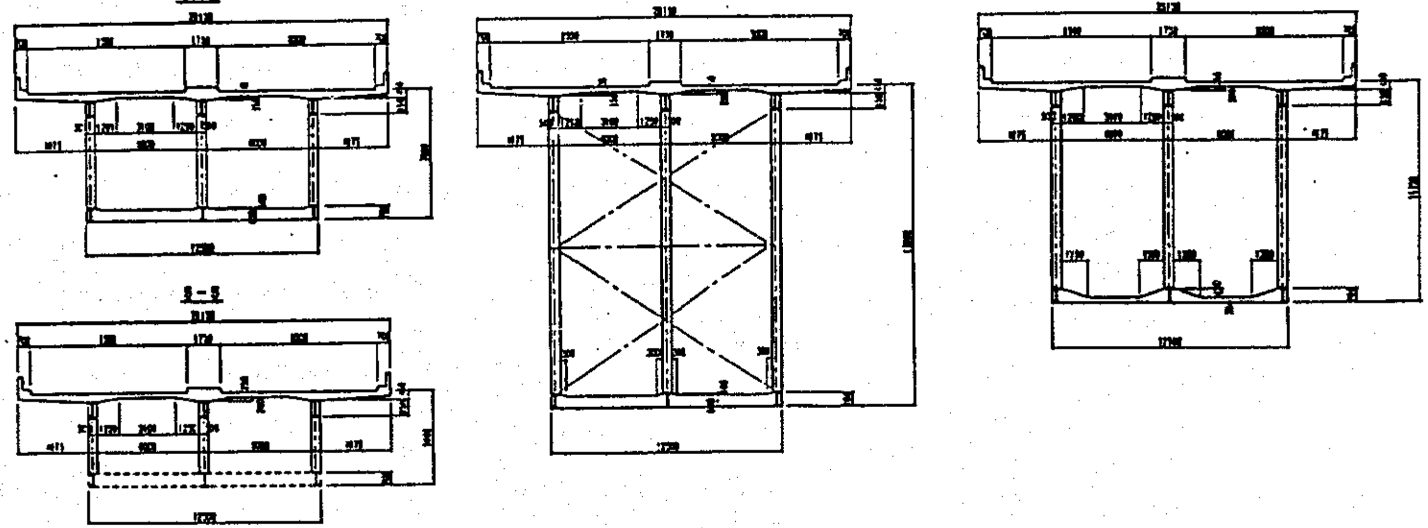
*Inherent Structural Frequency of Each Bridge

	Type-A	Type-B	Type-C
Hybrid Truss Bridge	2.62 sec.	2.76 sec.	5.45 sec.
Ordinary PC Girder	1.3 sec.	1.7 sec	--------

Profile



Section



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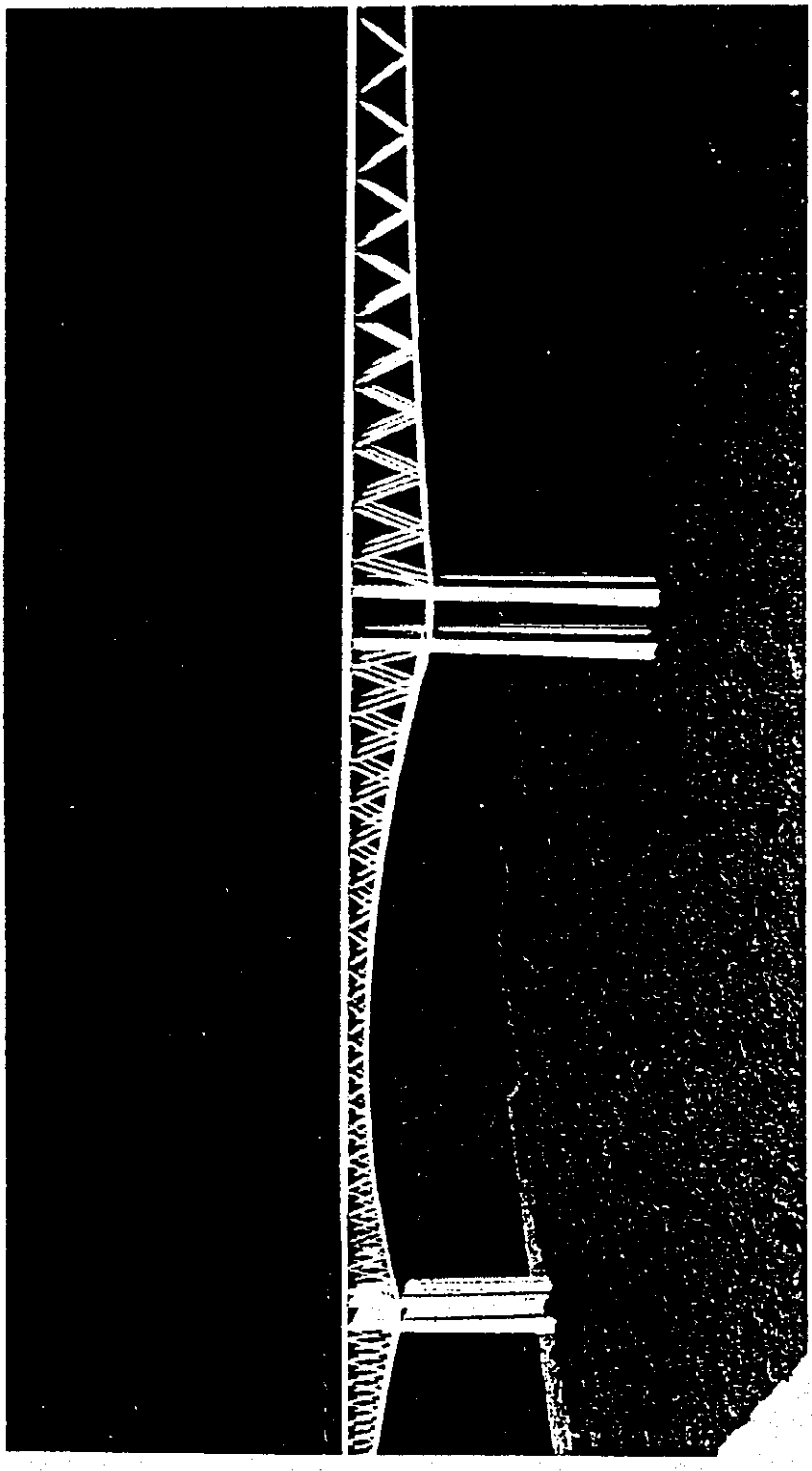
	A	B	C	備考
Span (m)	460.0	584.0	900.0	
Overall Width (m)	16.4	20.2	20.2	
Effective Width (m)	15.0	8.5×2 =17.0	8.5×2 =17.0	
L_1 (m)	180.0	240.0	380.0	Clear Span

Comparative Cost Analysis of A, B and C Type Bridge

	Type-A	Type-B	Type-C
Matrials of Superstructure			
Concrete	13,549 m3	14,211 m3	22,347 m3
PC Tendon	280 ton	488 ton	905 ton
Reinforcement	1,355 ton	1,421 ton	2,235 ton
Truss Steel	2,300 ton	4,100 ton	9,500 ton
Forms	12,100m2	17,970m2	27,635m2
Cost of Hybrid Superstructure (Japanese Yen)			
	3,030 Millin	4,760 Million	10,230 Million
Cost per Unit Squre Meter of Hybrid Truss			
	420,000	450,000	660,000
Cost per Squre Meter of Ordinary PC Bridges			
	PC Girder	PC Cable Stayed	Steel Cable Stayed
	450,000	600,000/ 700,000	900,000/ 1,000,000
Cost Merit of Hybrid Truss per Squre Meter (Yen/m2)			
	30,000	250,000	340,000



*<u>Construction Method</u>

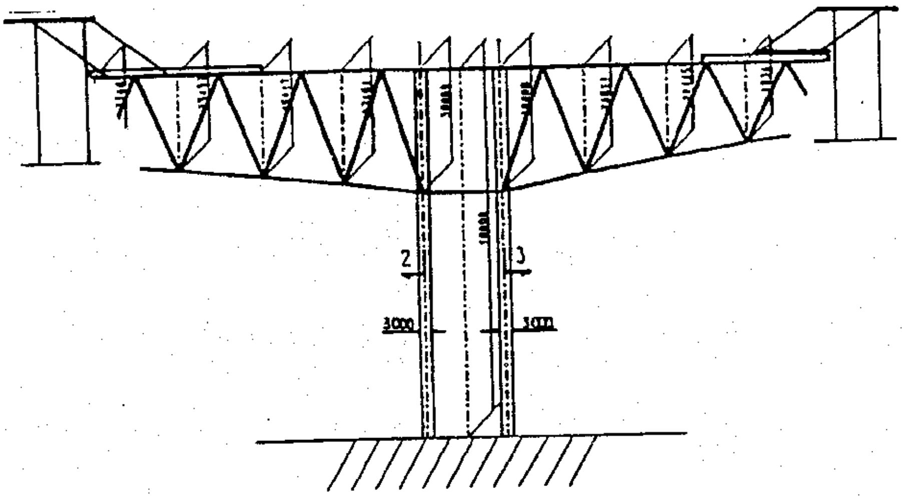
-<u>Factory Made</u>

*Prefabrication of Upper Deck

* Standard Panels of Each Unit Member

-Construction on Site

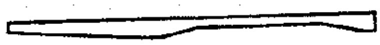
*Cantlever Erection Method

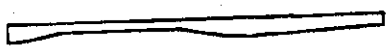


*Prefabrication in Factory

Upper Chord + Brace

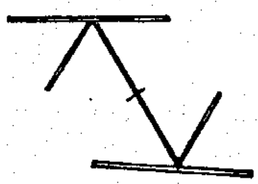
Precast Slab





Lower Chord + Brace

Precast Slab



Jointing by Hightention Bolt and Welding

6. FURTHER THEME TO BE SOLVED

*Improvement of Structual Quality

*High Strength Concrete of 500~600 kgf/cm2

*High Tension Steel

*Concretere Filled Column (steel pipe) for High Compressive Member

*Improvement of Structual Details

*Joint Metod of Concrete Slab and Steel Truss Member

* Improvement of Construction Method on Site

*Standardization of Prefabricated Slab Member

*Application of High Performance Concerete to Slab

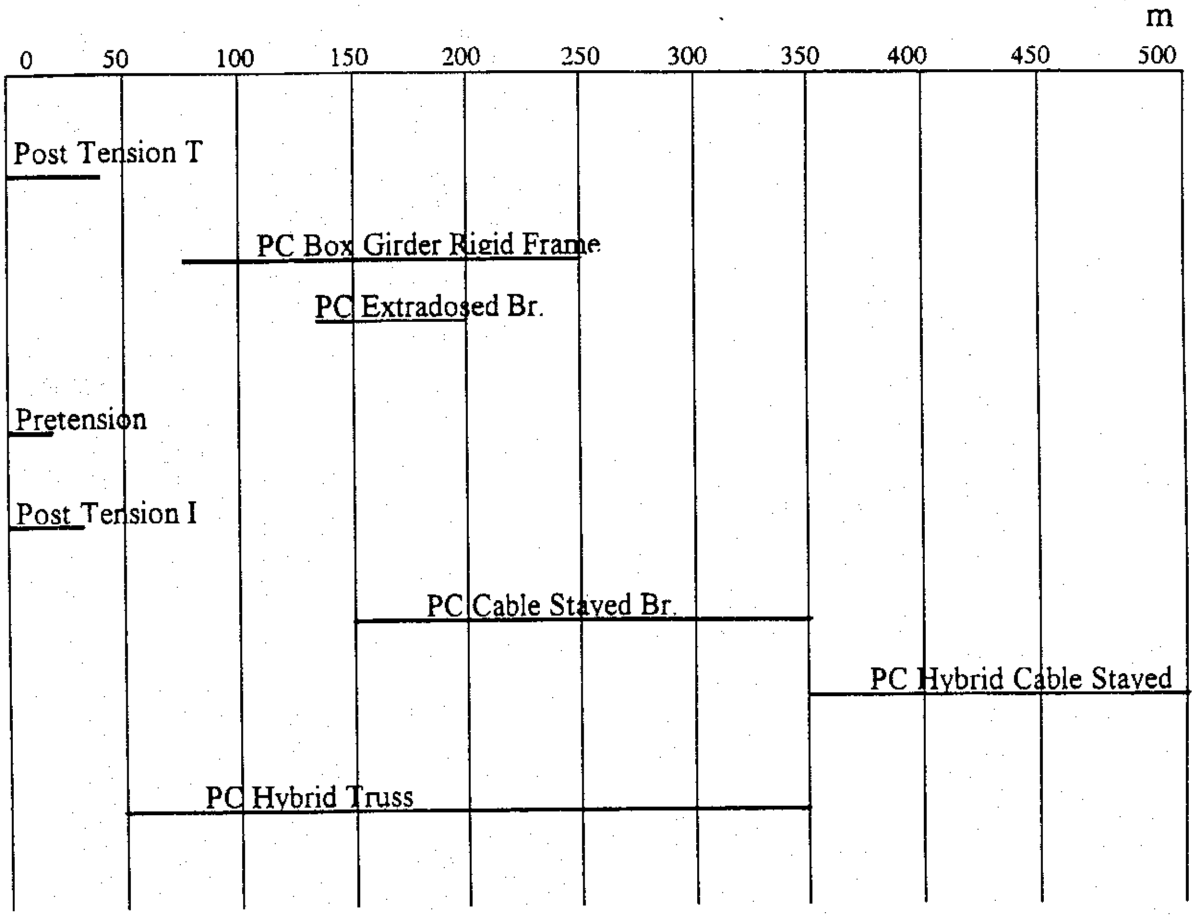
*Conbination of Unit Members

*Cost Saving for Maintenance

*Application of Weathered Paint for Truss Steel

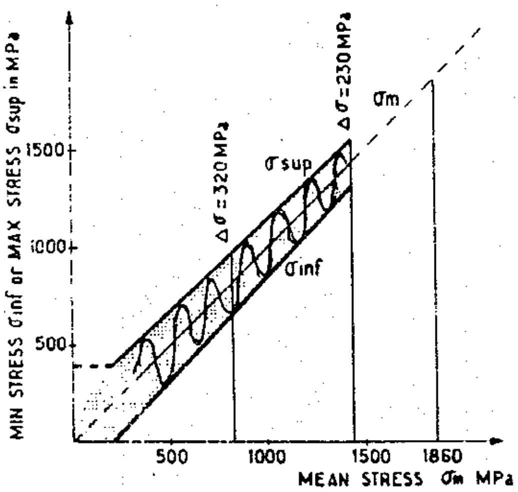
Annex-1

Applicable Bridge for Span Length

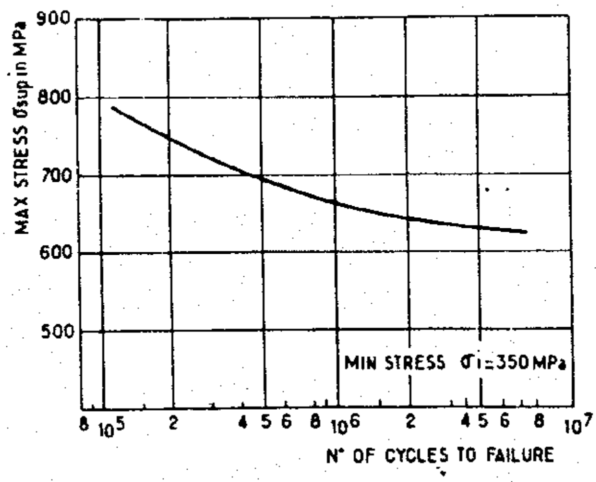


Annex-2 Reduction of allowable stress due to fatigue by cyclic load

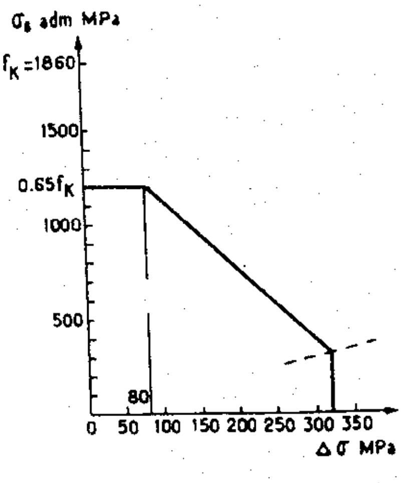
The fatigue properties of the strand may be described through SMITH diagram, generally established for $2x10^6$ cycles, and WÖHLER curve (S-N curve) for which the upper, the lower or the mean stress has to be chosen. Mean stress is based on dead loads. Cyclic stress is due to changeable load such as live load. If changeable stress range is bigger, allowable stress will be smaller. Therefore, anchorage of cable stayed bridge has devices to reduce changeable stress range for fatigue.



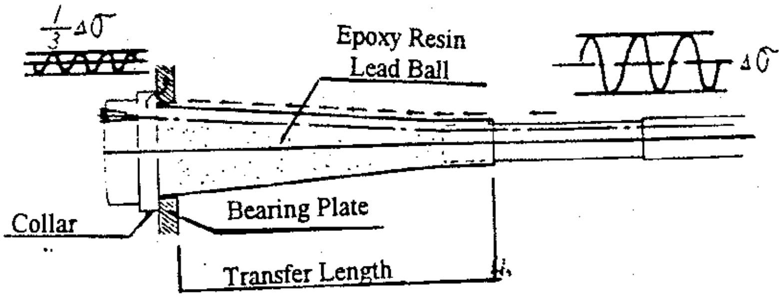
SMITH-Diagram 2 x 10^6 cycles for a seven wire strand.



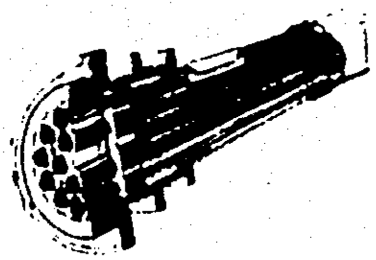
Expected S-N curve for a seven wire strand.



Admissible upper steel stresses as a function of the stress range.

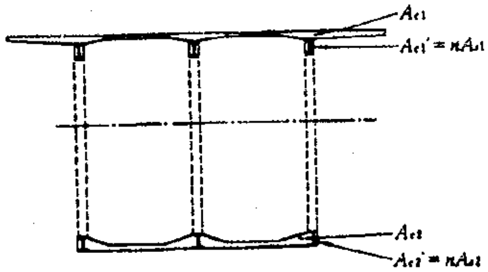


Anti-fatigue System of Anchorage (PC Cable Stayed Brd.)



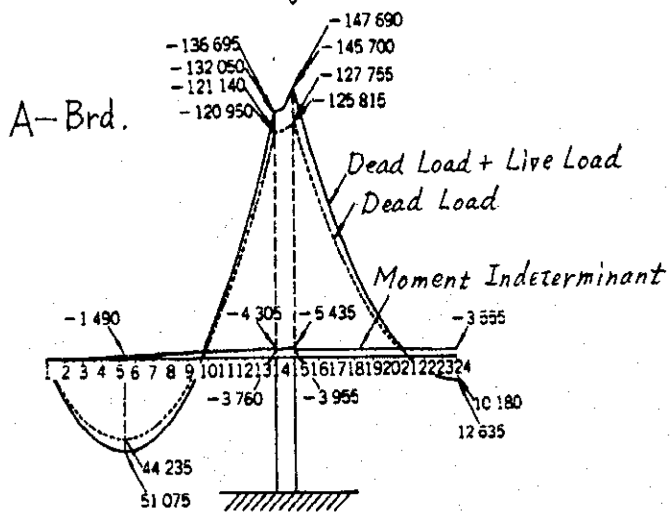
Anchorge of PC Etradosed Brd.
(Normal Anchorage)

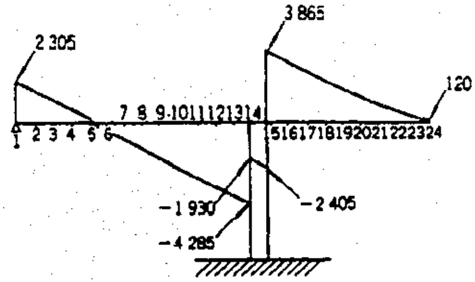
Annex -3

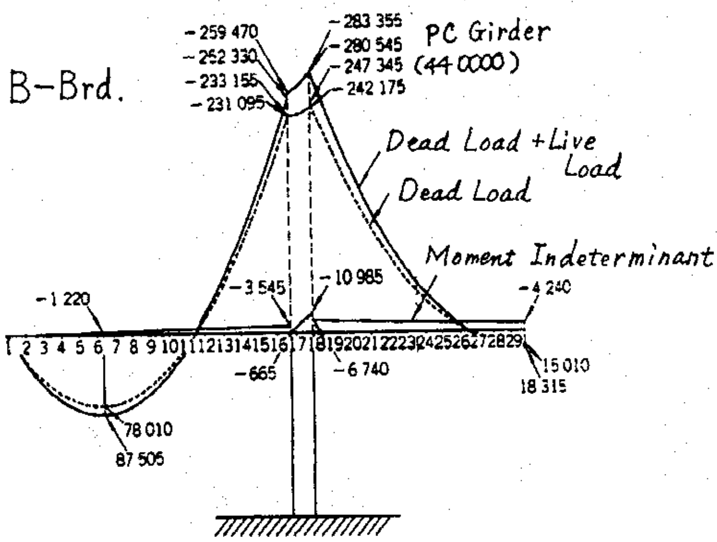


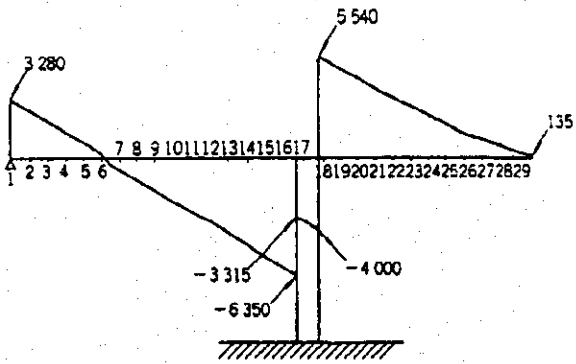
Bending Moment (tf·m)

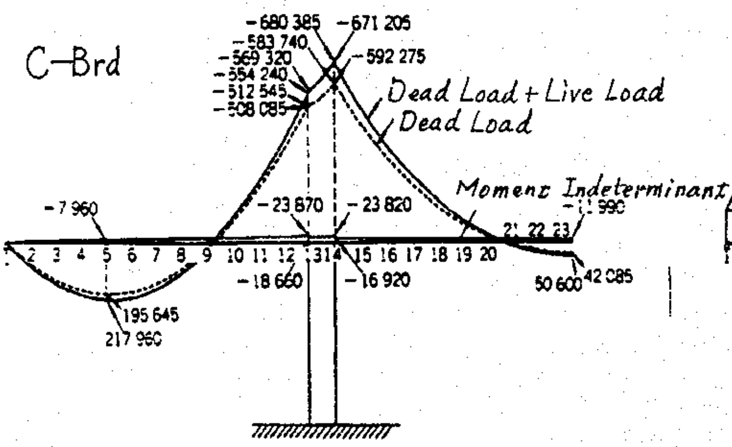
Shear Force (t·f)

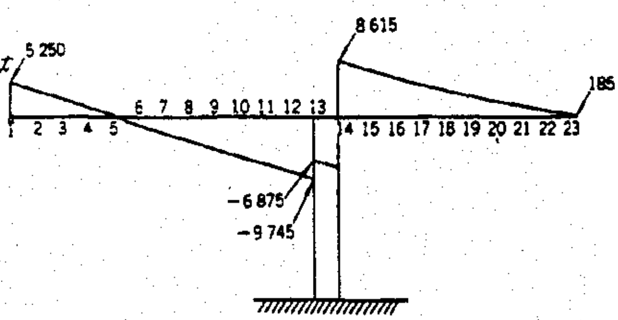












2. Construction Methods for Deep Foundation of Bridge

- Sinking Work Methods for Caisson Foundation
- Automatic Operation of Sinking Open Caisson Foundation

21st January 1998, Ho Chi Minh City

Construction Methods for Deep Foundation of Bridge

(1) Sinking Work Methods for Caisson Foundation

- Possible to control incline of the caisson stein (wall).
- Accomplish the foundation works under the limited construction time
- Minimize troubles with the adjacent existing bridge structure

(2) Automatic Operation of Sinking Open Caisson Foundation

- Possible to sink the caisson foundation to the depth of 100 m
- Caisson size (diameter of excavation) from 6 m to 25 m
- Totally cost minimization can be expected 30~40% compared with conventional method
- Applicable for even higher quality and shorter construction period by applying segmental method

SINKING WORK METHODS OF CAISSON FOUNDATION

1. Sinking Work Method

a) Sinking down by Self-weight of caisson stein.
b) Reducing skin friction resistance by using ; bentonite steel plate, sand, and water or air jetting
c) Forcing sinking caisson stein by hydraulic jacks.
d) Excavating Caisson Inside by computer- controlled bucket.

2. Reasons for Selection of Jack Down Method

a) Difficulty of Self-weight Sinking due to presence of the dense silty clay or clay silt below the sand layer (0 ~ 15m)
b) Possible to control incline of caisson stein, if any, during sinking work by hydraulic jacks.
c) Accomplish the foundation works under the limited construction space and time.
d) Minimize troubles with the adjacent existing bridge structures.

3. Sequence of Operation

a) Drilling
b) Grouting Cement Paste
c) Inserting PC Strand
d) setting Anchor Head & Coupler
e) Connecting Gripper Rods
f) Setting Beams and Hydraulic Jacks
g) Excavating Caisson Inside
h) Jack Down Caisson Stein

JACKDOWN SYSTEM FOR CAISSON SINKING

Jackdown system for caisson Sinking

SYNOPSIS:-

Jackdown system for caisson sinking is a precise and innovative method of controlled sinking within allowable limits of tilts, shifts and rotation of caisson at any stage of its sinking. The basic principle of this method is to pressurize the caisson by hydraulic jacks with the help of soil anchors. Soil anchors are constructed at predetermined locations around the caisson and are pulled by hydraulic jacks which are placed on the top of caisson, resulting in the pushing of caisson inside the ground. This method has been used probably first time in India on Nizamuddin Bridge on NH-24 in New Delhi which is being constructed by M/s Obayashi Corporation of Japan under Japan's Grant Aid scheme. Employer for the Project is Ministry of Surface Transport Government of India and Engineer's are M/s Nippon Koei Co Ltd. Japan in association with Katahira & Engineers International Japan. M/s Intercontinental Consultant & Technocrats (P). Ltd are domestic consultant with M/s Nippon Koei. co. Ltd and M/s Engineering Construction Co., of L&T group are the sub-contractor of M/s Obayashi Corporation for the bridge portion. Jack down method is more systematic and mechanized system for sinking of caisson and has been successfully used on this project for sinking 7.1m X 15.1m oval shaped caisson up to 36m depth.This paper mainly deals with the methodology and characteristics of Jackdown system and its application to engineering construction with a special reference to Nizamuddin Bridge Project.

CONCEPTUAL IDEA OF JACK DOWN METHOD

Conceptual idea of Jack down System has been shown in Figure 1 The Principle of this system is to push down the structure into the ground by applying pressure from the top by Jacks and jacks in turn take reaction from soil anchors to counter the resistance of soil due to skin friction around the periphery of caisson and below the cutting edge. The load applied by jacks may be hundred to thousand tons depending upon the shape, size and depth of structure to be sunk and the soil conditions. Jacks are operated individually or jointly and the load on various jack is controlled so that structure is sunk in plumb and straight without tilts, shifts and rotations. Soil anchors or ground anchors of required depth are constructed around the structure at proper location and of required depths so that they are strong enough to take the reaction of jacks.

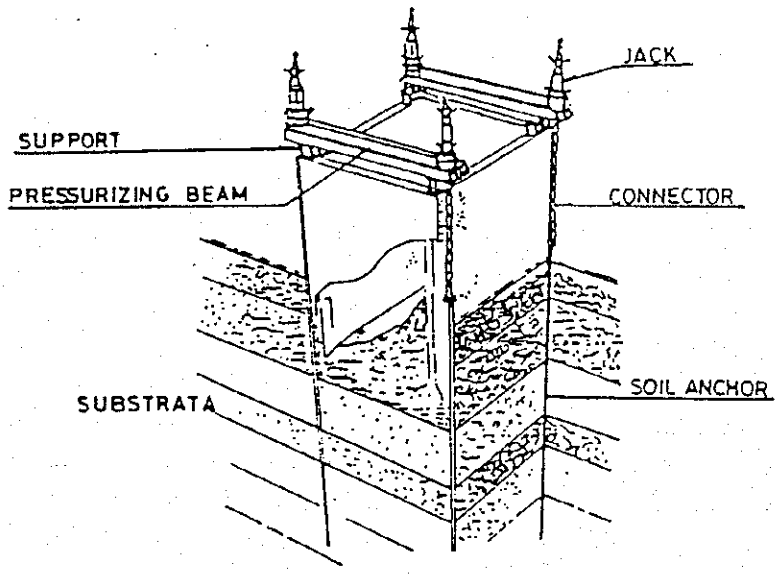


Fig. 1- Conceptual idea of Jackdown method

APPLICATION OF JACKDOWN METHOD

This method is becoming more and more popular in recent times due to its simplicity and application in very restricted work areas with ease in sinking of caisson and structures of large and non-standard size and shape with high depth of foundations in various type of soils without problems of subsoil water level.

Jackdown method has been extensively used for sinking of caissons for pier foundations but it can also be used for various other type of structures such as shafts of sealed sewerage work, artificial river channels, underground rooms, manholes, underground parking and deep shafts etc.

CHARACTERISTIC OF JACKDOWN METHOD

Jackdown method has number of advantages in execution of projects which can be summarized as below:-

(i) Caisson/Structure can be sunk with extreme accuracy without tilts and shifts because in this system it is easily possible to control inclination and horizontal movement during sinking.

(ii) Occurrence of sand blowing or quick sand condition during sinking causes excessive tilts in the caisson and hampers the progress of work. This method reduces the chances of sand blowing or quick sand conditions below the caisson due to contolled dredging and sinking operation.

(iii) There are least chances of disturbances in surrounding areas and minimum changes in characteristics of sub-soil strata due to controlled cutting of soil friction and controlled sinking operation.

(iv) This method is capable of sinking caissons and structures of non standard size and shape in any subsoil strata with the help of some accelerating method of sinking like air jet and water jet method.

(v) This method require very small working space and area on the structure which is required to be sunk.

(vi) The system is very effective in hard and stiff strata and at higher depths when frequent loading and unloading of caisson becomes necessary which is time consuming and cumbersome process..

(vii) There are least environmental problems at site such as noise and vibration.

(viii) This method is very safe and systematic and as such there are little chances of accident.

OPERATIONS INVOLVED IN JACKDOWN SYSTEM

The operations involved in Jackdown system are:-

(i) Making of soil anchors
(ii) Casting of caisson wall/Structure
(iii) Installation of Jackdown system
(iv) Excavation from inside caisson/structure
(v) Pressurizing of caisson/structure.
(vi) Removal of Jack down system.

COMPONENTS OF JACKDOWN EQUIPMENT

Jackdown equipment is composed of following items as shown in figure 2.

(i) Anchor coupler
(ii) Adjustment coupler
(iii) Gripper rod
(iv) Steel support
(v) Pressurizing steel beam
(vi) Pressure plate
(vii) Hydraulic Jack - Central hole type
(viii) Upper & lower Grippers
(ix) Hydraulic Power unit

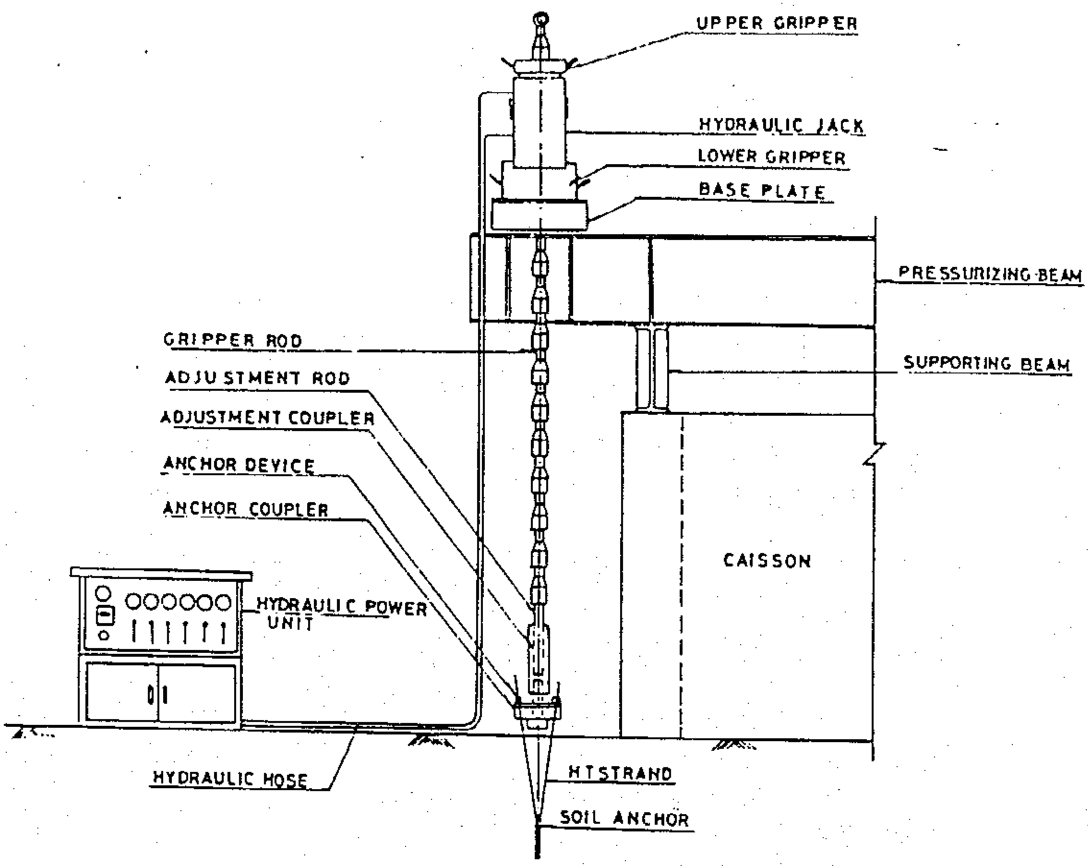


Fig. 2- Components of Jackdown equipment

Brief description of these items along with figure and photographs is given below:-

1. Anchor coupler with anchor device:-

These are made of high tension steel and are used for anchoring HT strands of soil anchors which projects above the ground as shown in figure 3.

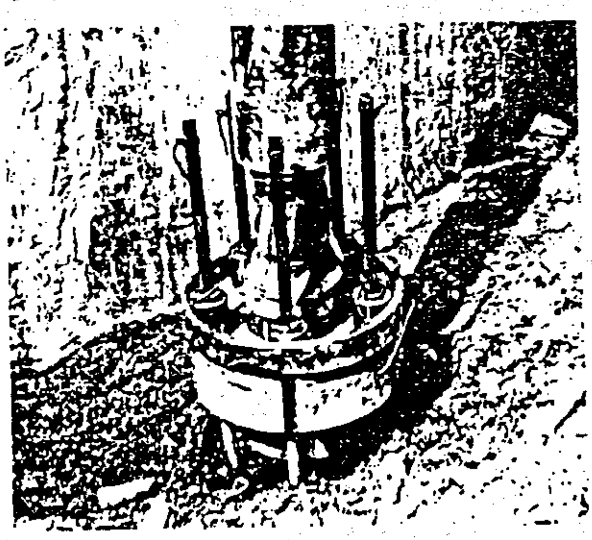


Fig. 3- Anchor Coupler

2. **Adjustment coupler and adjustment rod:-**

These are used for connecting the gripper rod with anchor coupler fixed at the top of soil anchors and also for adjustment of length of the gripper rods of each soil anchor in the beginning and after each stroke if required.

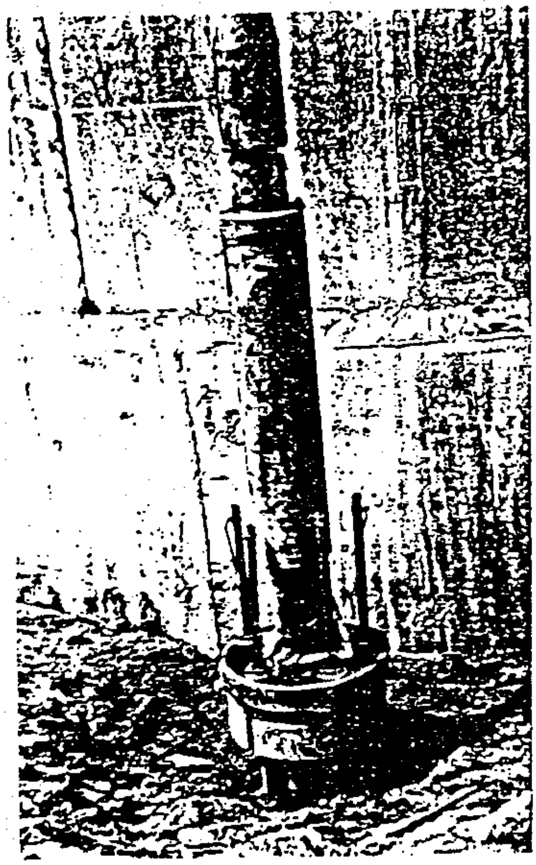
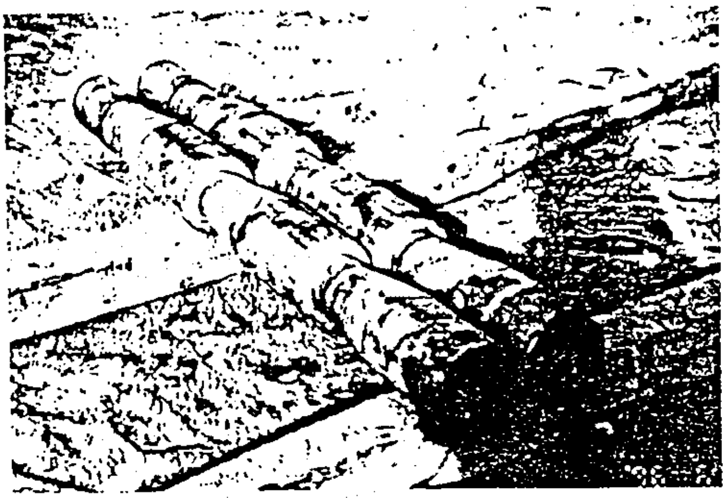


Fig. 4 Adjustment Coupler and Adjustment rod

3. **Gripper rod:-**

Gripper rods are of special shape and size as shown in figure 5 to connect adjustment coupler with the jack. The length of individual piece of gripper rod is 1.110m (excluding threaded portion) with threading on both ends for joining one gripper rod with another gripper rod to increase its length as per requirement. The gripper rod has conical shape in steps so that it is gripped by grippers fixed in the body of hydraulic jack for taking reaction from soil anchors. The threads provided for joining two gripper rods have buttress type thread to withstand high tensile stresses developed during jacking operation.



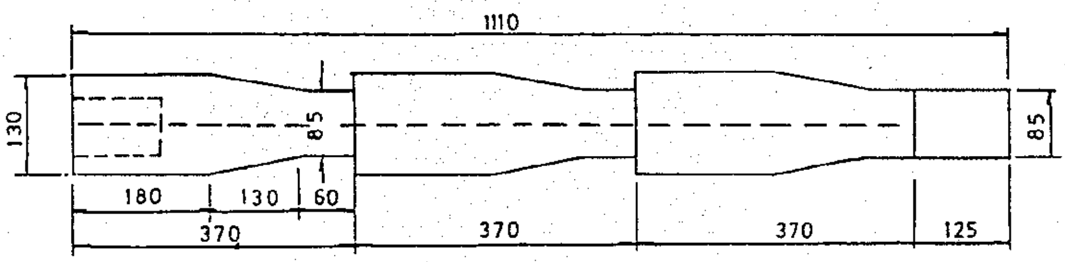


Fig. 5- Details of Gripper rod

4. Supports and pressurizing steel beam:-

Support and pressurizing steel girder are fabricated steel members and are placed on the top of caisson or structure at predetermined location on which the hydraulic jacks are placed.

5. Hydraulic jacks:-

Hydraulic jacks of required capacity are of central hole type i.e it has a central hole through ram which allows the gripper rod to pass from the body of jack. On applying hydraulic pressure cylinder move down and the ram remains stationary. Upper gripper is fixed with the ram by four bolts and lower gripper is fixed at the bottom cylinder base and moves down with the jack body.

The Hydraulic jacks pressurize the caisson and pulls the gripper rod which is connected to soil anchors through anchor coupler to sink the caisson.

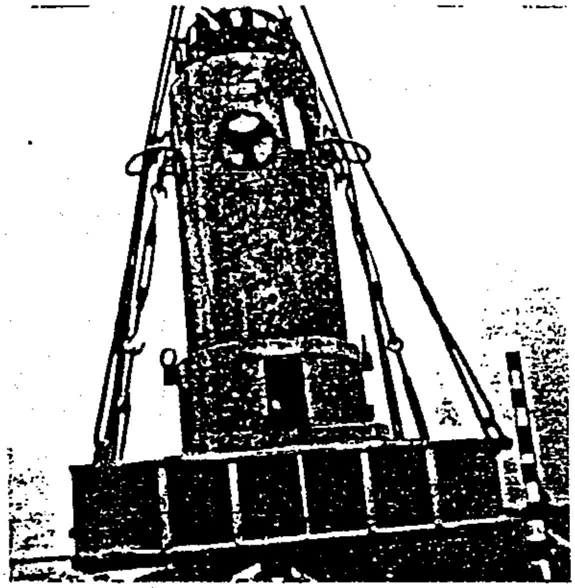


Fig. 6 Hydraulic jack

6. Grippers

Grippers have conical hollow shape housing called jaw housing in which four jaws are placed to hold the gripper rod. Jaws are connected with spring which allow the change of diameter of jaw assembly and enable to hold the gripper rod which is of variable diameter.

There are two grippers i.e. Upper and Lower gripper. The upper gripper is fixed with body of ram at the top and lower gripper is fixed at the bottom of body of jack cylinder. When pressurizing is done ram remains stationary and upper gripper fixed to ram take reaction from soil anchor through gripper rod and lower girpper moves with the body of jack and slide along the gripper rod to exert pressure on caisson to penetrate into the ground.

7. Hydraulic Power Unit

Hydraulic Power Unit controls the operation of jacks. The Jacks can be operated individually or collectively and the load on each jack can be varied as per requirement.

JACK DOWN MECHANISM

The jack down mechanism to pressurize the caisson/structure is carried out in the following steps as shown in Figure 7.

(1) The Upper gripper grabs the gripper rod, and the hydraulic jack is extended to exert pressure on the structure.

(2) When the stroke of hydraulic jack extends, the lower gripper engages with the gripper rod and pressure is exerted on the structure by taking reaction from anchors. Ram remains stationary and jack body moves down to push the structure into the ground. In this process lower gripper engages gripper rod and automatically moves down till it reaches up to the bottom of gripper rod where it moves to next gripper rod and gets locked. In this way caisson is pushed down by 37 cm i.e equal to one segment of gripper rod in each stroke.

(3) The upper gripper is now disengaged from the gripper rod, the jack stroke is released and upper gripper is fixed to the neck of the next gripper rod.

(4) Step 1 to 3 are repeated to continue the jacking down process till the sinking of the lot is completed.

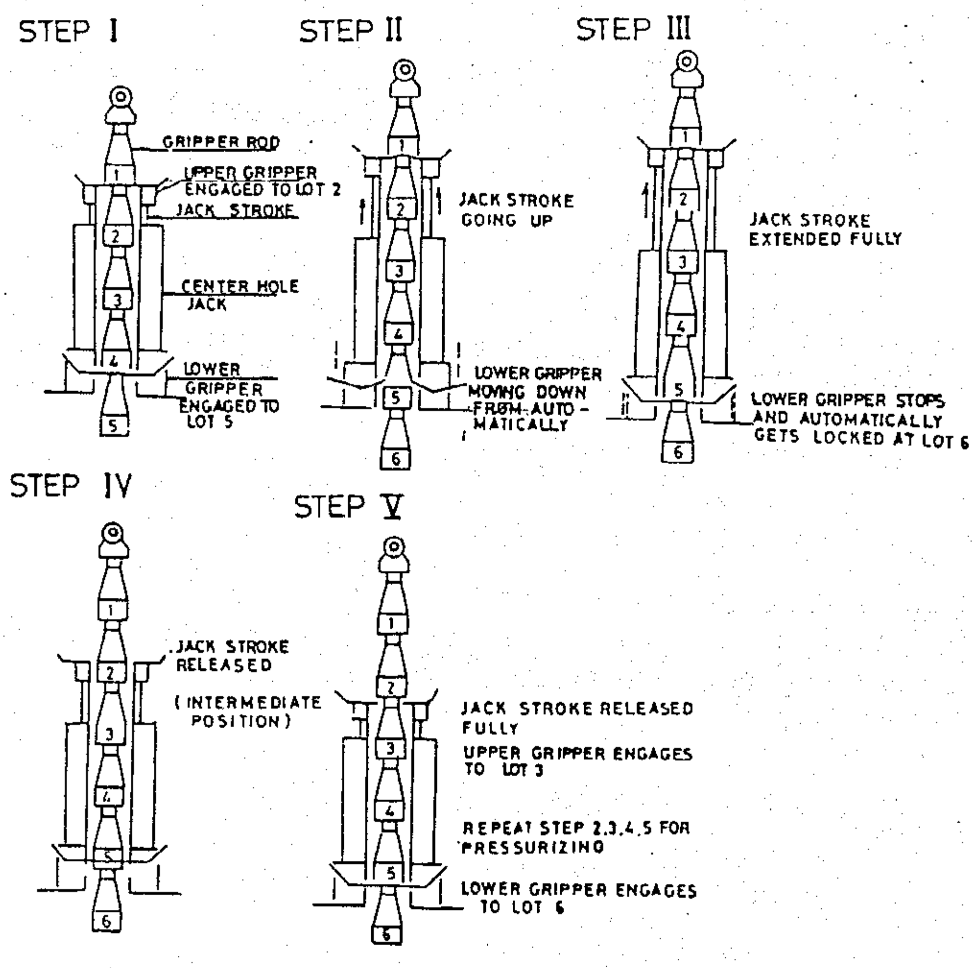
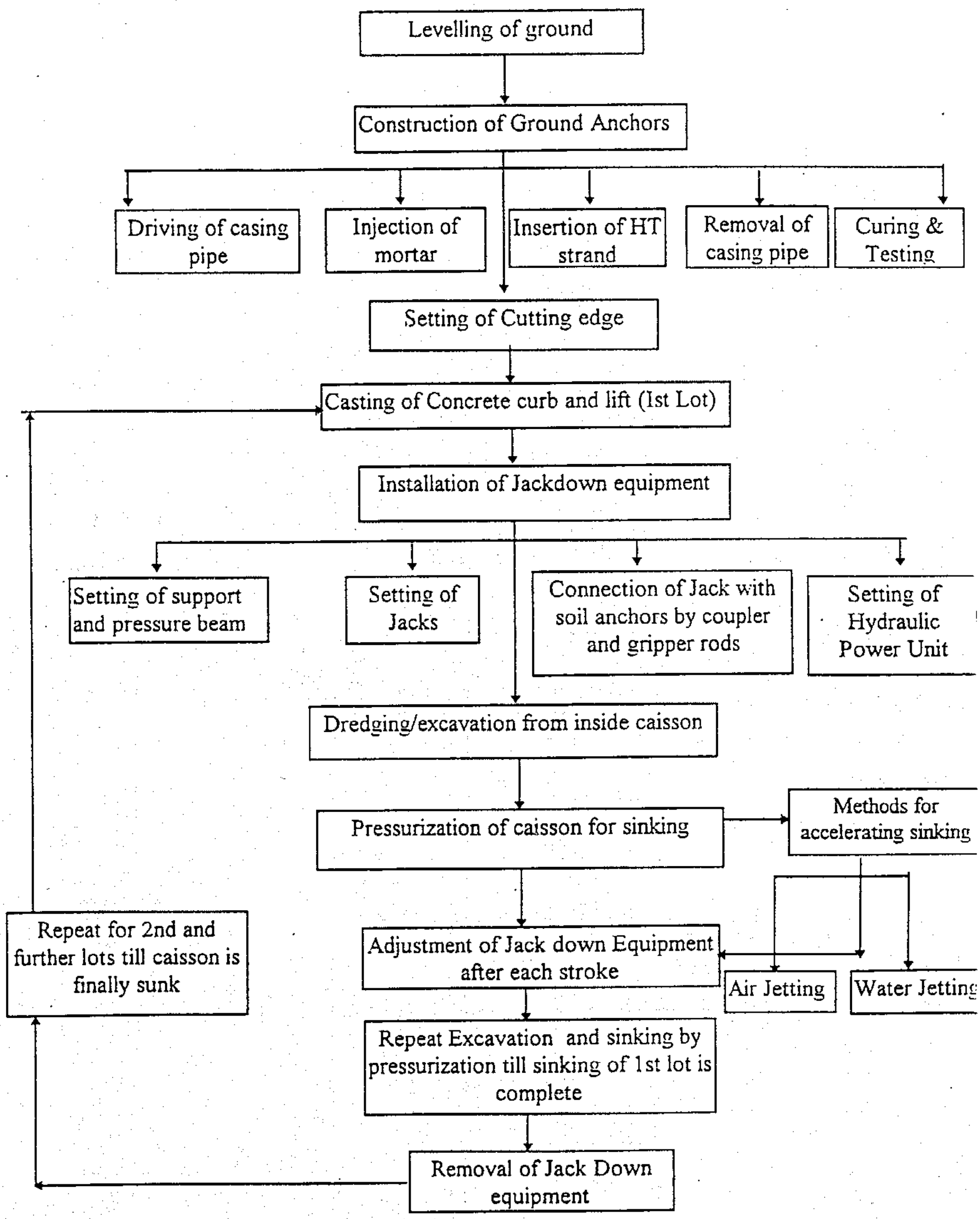
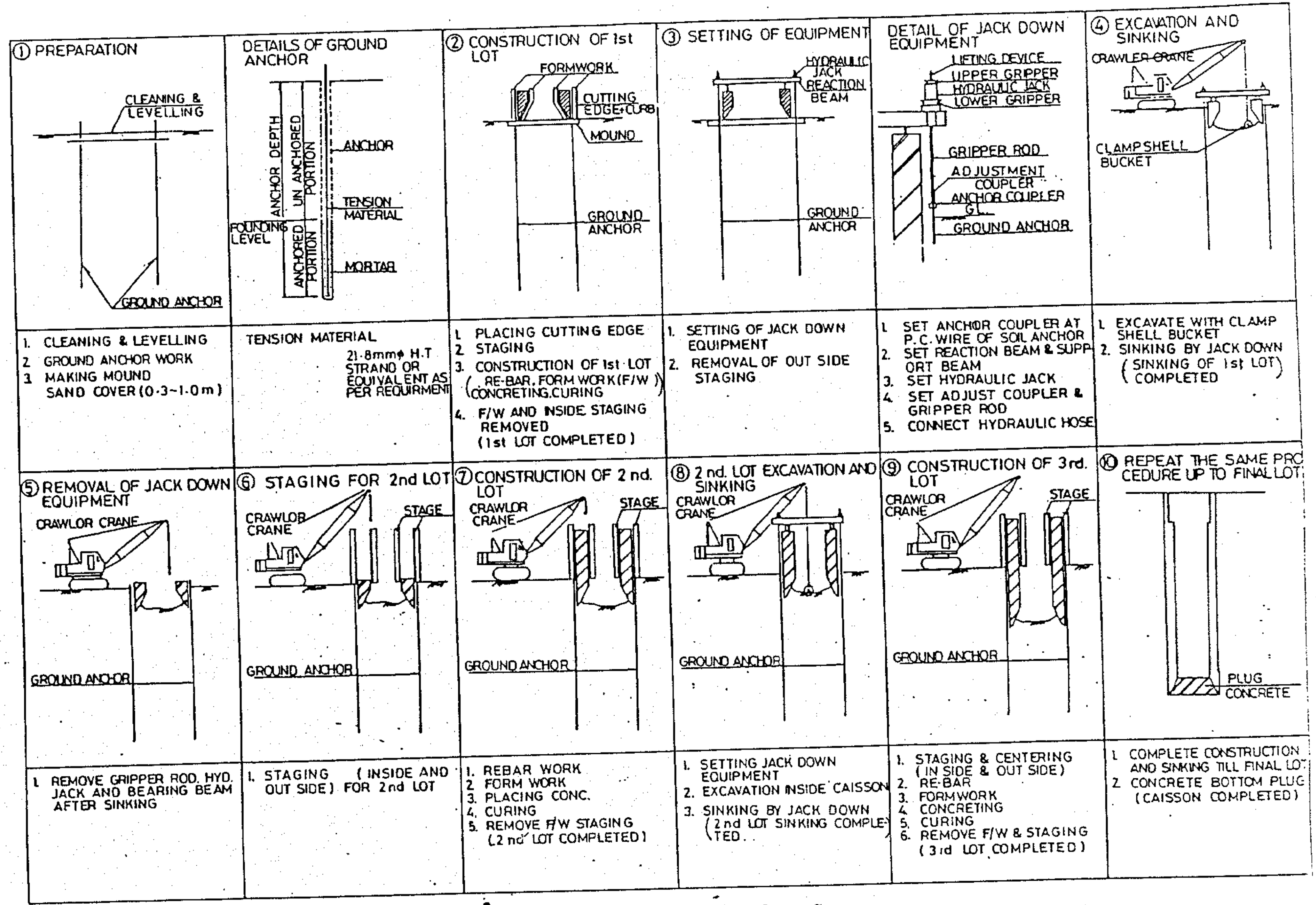


Fig. 7 Pressurization Mechanism

Flow Chart for construction of Caisson foundation by Jackdown Method



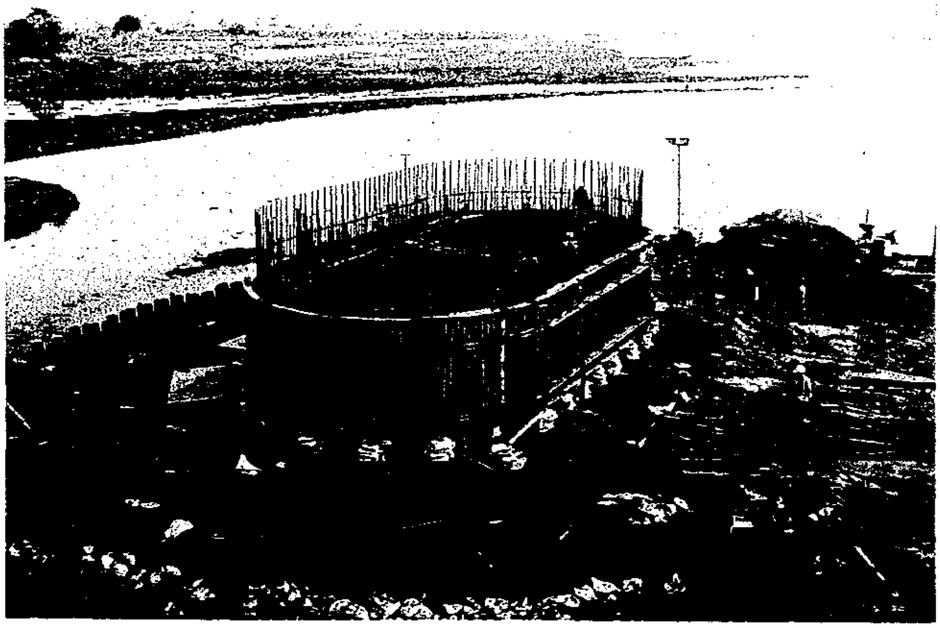


•Sequence of Activities of Jackdown System

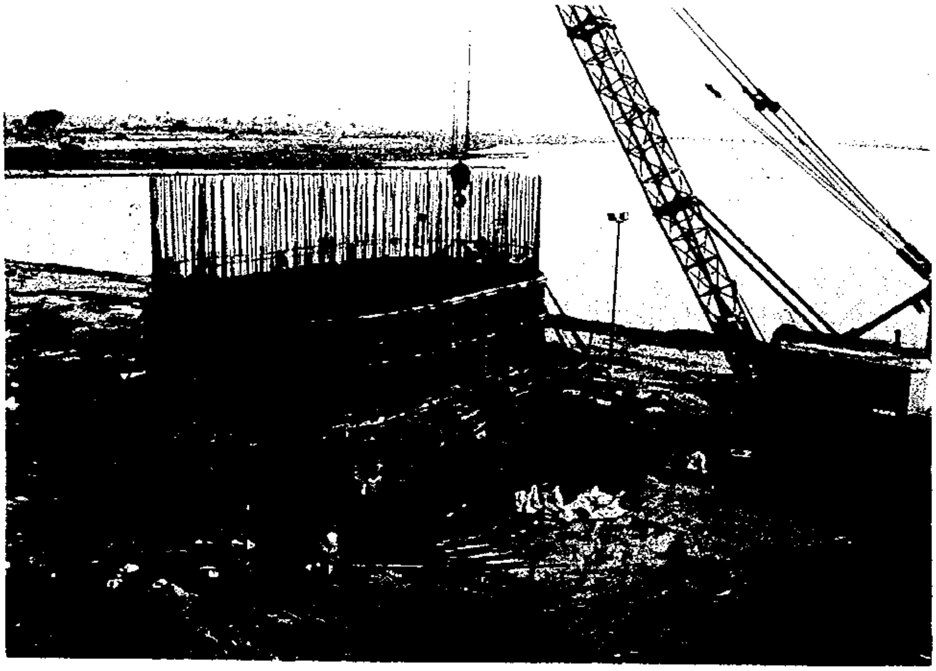
PROGRESSIVE SHOTS
FOR
CONSTRUCTION OF CAISSON FOUNDATIONS

NIZAMUDDIN BRIDGE, NOVEMBER *1996*

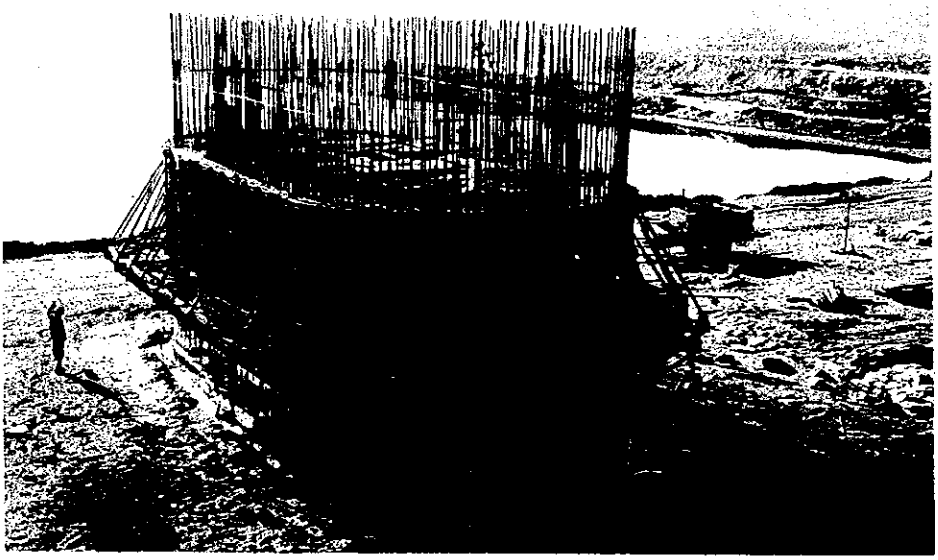
(1) Setting Shoe



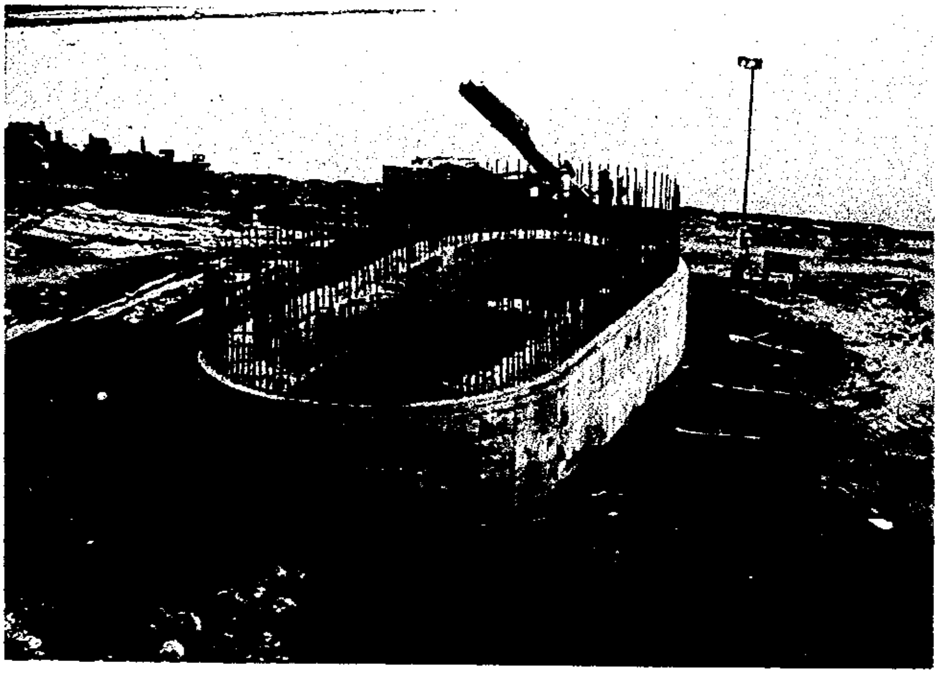
(2) Removal of Forms



(3) Form Works

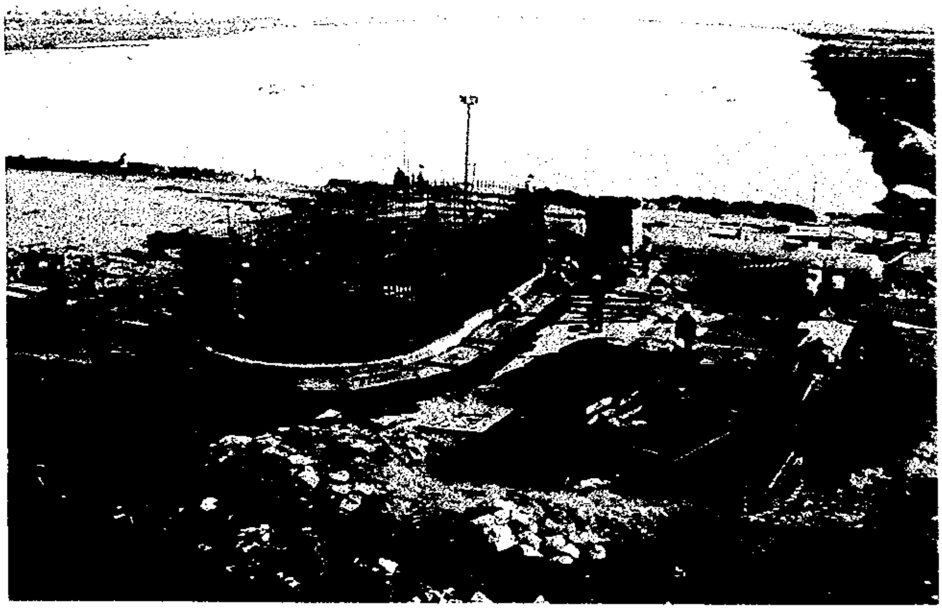


(4) After Pouring Concrete

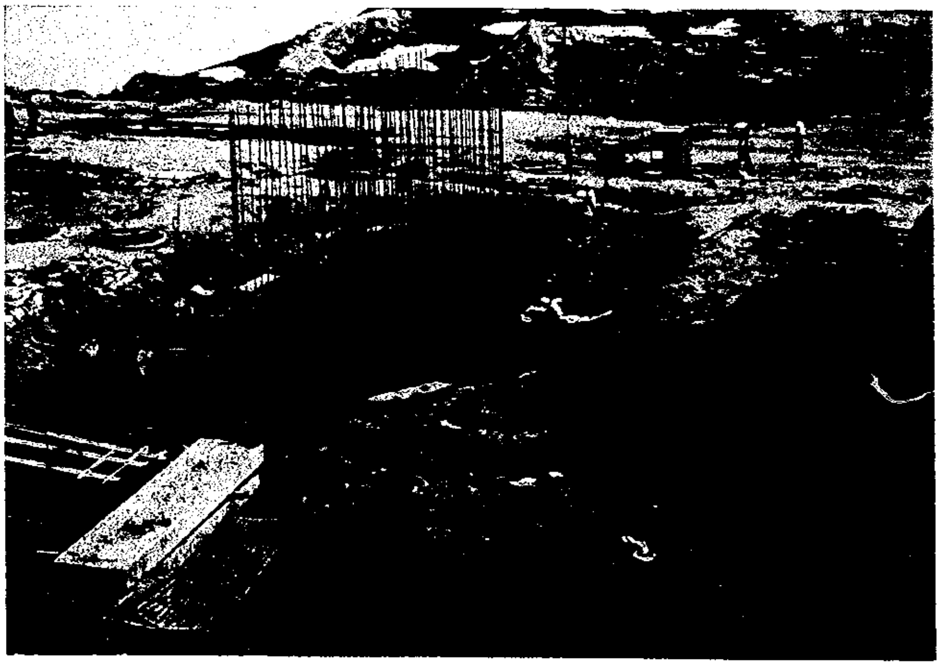


(5) After Removal of Forms

(6) Jacking Down of Caisson Stein

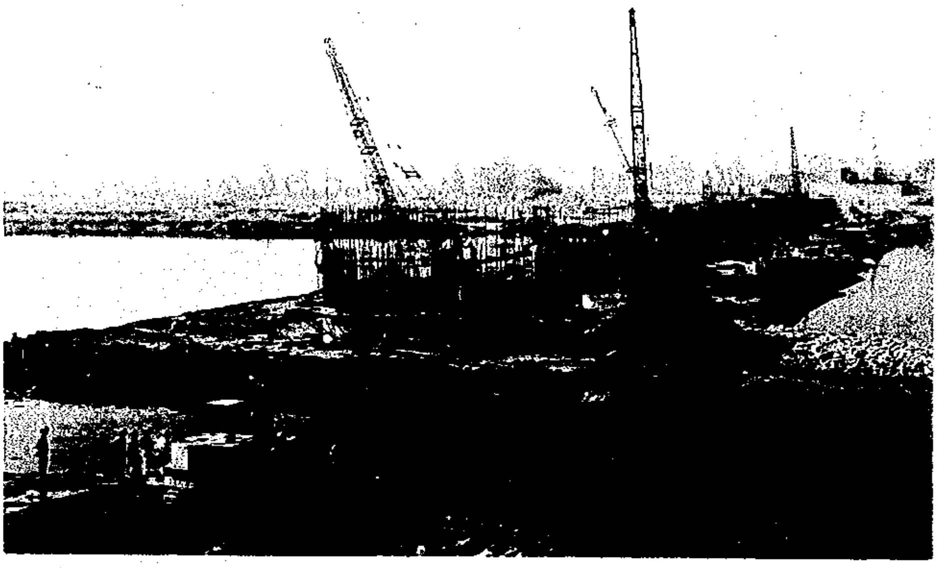


(7) Form Work Preparation for Next Lot

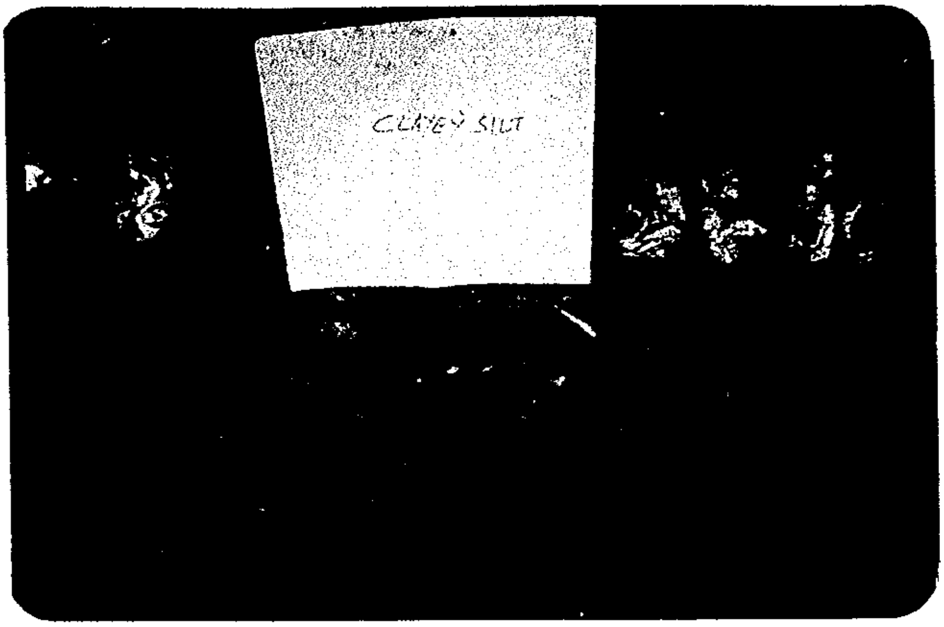


(8) Re-Bar Works of Pier Shaft

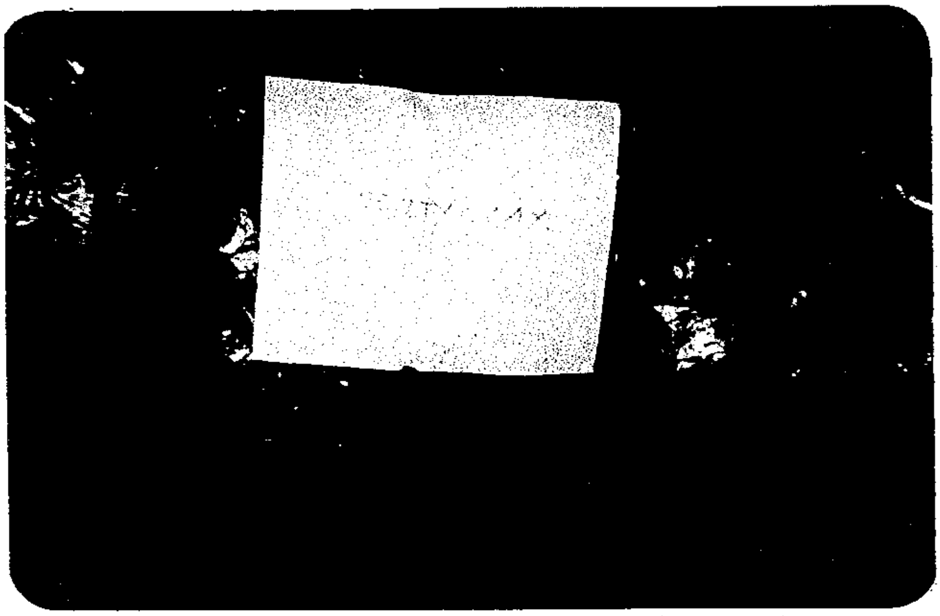
(9) Form Works of Pier Shaft



(10) Works of Caisson Foundations



Soil Sample from CLAYEY SILT Strata



Soil Sample from SILTY CLAY Strata