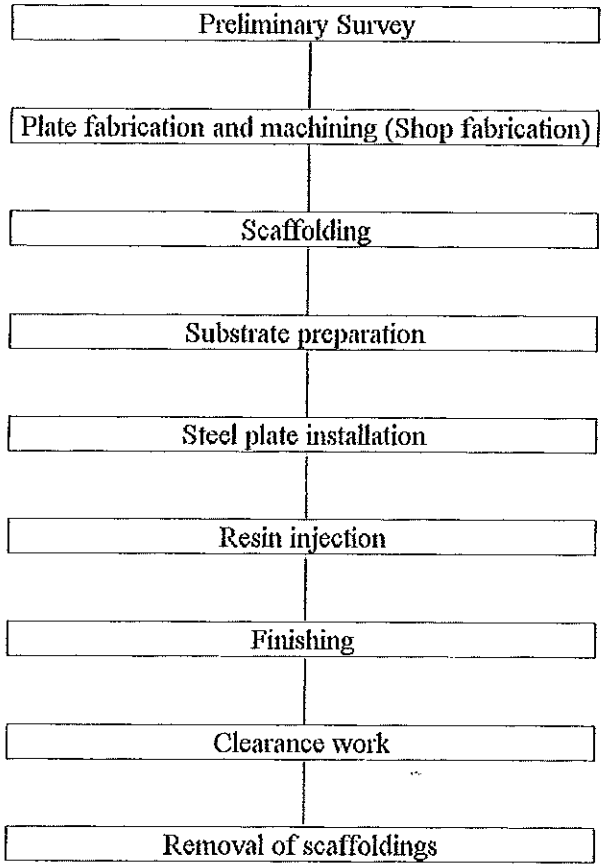
WORKING PROCEDURES
FOR
SHO-BOND STEEL PLATE BONDING METHOD

SHO-BOND CORPORATION

WORKING PROCEDURES



CHECK POINTS

Preliminary Survey	(1) Do the values and dimensions conform to those of the design documents? (2) Has the state of cracks, damage and steel corrosion been checked and cofirmed? (3) Does the surface comply with the surface flatness standard? (4) How are existing appurtenant structures positioned (e.g., power distribution pipes, gas pipes, etc.)?
Plate Fabrication and Machining	(1) Are the platemaking drawings adequate? (2) Have such documents as shop fabrication manuals and mill sheels been prepared? (3) Have the plates been sufficiently cleaned? (4) Are the as-built dimensions OK? (5) Is rustproofing treatment perfect?
Substrate Preparation	(1) Have sufficient cleaning and breaking been performed? (2) Is the substrate free of fatty and greasy deposits? (3) Is the concrete sound?
Steel Plate Installation	(1) Has boring been performed at right angles to the concrete surface? (2) Is the boring depth appropriate? (3) Have the anchors been perfectly anchored? (4) Is the necessary to conduct a pull-out test? (5) Have the steel plates been checked for identification of their front and rear surfaces? (6) Are the steel plates installed in a satisfactory manner? (7) Have spacers been installed? (8) Have the bolts been properly tightened? (9) Are the injection pipes coundly installed? (10) Are the seals perfect? (11) Is there any irregularity in the width of seals? (12) Has the injection depth been measured?
Resin Injection	(1) Has hardening of seal been confirmed? (2) Has antistaining suring been perfectly performed? (3) Is the position from which injection will be started correct? (Start from the lowest position.) (4) Is the injection pressure adequate? (5) Are the caps tightly installed? (6) Is injection complete without any portion left unfilled? (Confirm by hammering the surface with a wooden hammer.)
Finishing	(1) Has hardening of SB GROUT been cofirmed? (2) Has a hammering check been conducted? (3) Have the injection pipes and air pipes been completely removed? (4) Is there any place on the steel plates where resin has deposited? (5) Have sufficient coating intervals been taken?
Clearance Work	(1) Has the site been completely cleared?

WORKING SPECIFICATIONS

1. PRELIMINARY SURVEY

(1) Before starting work, conduct a survey while referring to the design drawings to check such mattes as the presence of honeycombs in the slabs, the state of cracks, damaged locations, surface flatness, and length and width of the flat surface area of slabs.
(2) Investigate the installed condition of such appurtenances as distribution pipes and gas pipes located in the periphery of the slabs, and consult with the persons and agencies concerned to study whether there may be any danger of damaging them during construction, or if their presence may impair workability.
(3) In the case of steel bridges, investigate the structure of such members as cross steel members to study whether the required construction conditions can be satisfied or not.

(1) Check the length and width of the flat surface area of the slabs to see that they conform to those of the design drawings. If any difference exists, make a check mark on the Check Point List. Then, necessary adjustments should be made in connection with plate machining work. After checking the state of the underside of slabs for such defects as honeycombs, the state of cracks, damaged locations and surface roughness, select the suitable reapir methods. Then, make necessary adjustments in conection with materials.
(2) If construction is not possible because of the installed distribution pipes and gas pipes, confer with the parties concerned to see if the pipes can be moved or not. Discuss what measures to take, and decide on the construction method to be adopted.
(3) Similarly to (1), when such members as cross steel members exist, check to see whether plate installation conforming to the design drawings is possible or not. If not, work out measures that would provide the required strengthening effect while allowing work to be carried out. Then, make necessary adjustments in connection with plate machining work.

2. PLATE FABRICATION AND MACHINING (SHOP FABRICATION)

(1) Based on the design documents and results of the site survey, such plate machining work as cutting, machining and welding are carried out at the shop.
(2) The steel plates thus cut and machined, are subjected to surface treatment, and then given a rustproofing coating.
(3) The steel plates are delivered to the site.

(1) After confirming the shape, dimensions, quantities, etc. of the steel plates to be bonded at the site, the plates are subjected to shearing, or automatic gas cutting operations at the shop. Welded portions of the steel plate such as haunches are formed by electric welding. (Sometimes, welding is performed at the site.)
(2) Surface treatment for the steel plates consists of cleaning the overall plate surface by such means as sand blasting, shot blasting and sanding to the extent no skin remians on the plate surface. After applying an etching primer to both surfaces of the steel plate for rustproofing, deliver the plates to the site. Prior to applying the etching primer, wipe the coating surface with a dry rag. Plates with significant spots and stains

should be wiped and cleaned with a rag and thinner, and removed of all fatty and greasy substances, dirt and dust.

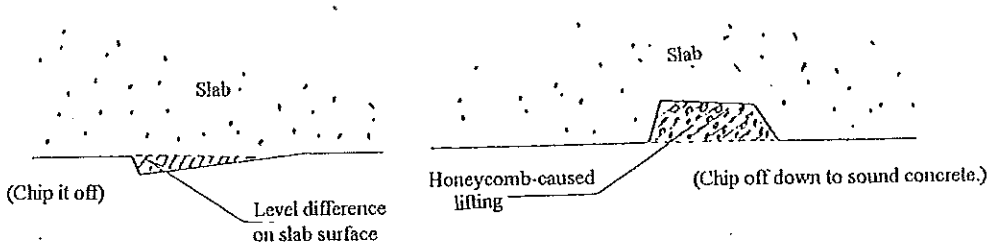
(3) If the site is unfit as a plate yard for open-air storage, pile the steel plates either under the bridge, or on the scaffolding with a support placed under them. (Cover the plates with a sheet ordinarily used for curing.)

3. SUBSTRATE PREPARATION

(1) Projections found on the underside of slabs (the steel plate bonding surface) such as level differences producted by a form should be chipped off with a flat chisel, or a similar tool.

(2) Clean the substrate with a disk sander to remove all free lime, dirt and dust. Also remove all fatty and greasy substances.

(1) Using a flat chisel, chip and level off projections produced by construction joints of forms so that the bonding surface will be free of all surface irregularities at the time the plates are mounted. (See Fig. 3-1.)
If there are any places where the concrete covering over the reinforcing bars has lifted, remove all such portions of concrete, and restore the covering by filling SHO-BOND #101.



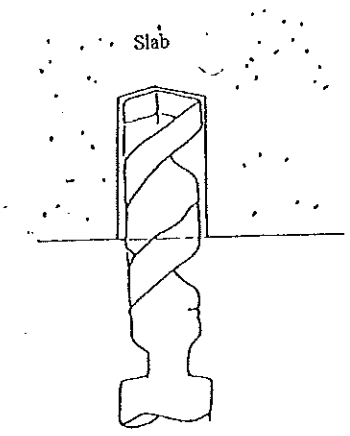
(Fig. 3-1)

(2) Remove all free lime, dirt and dust from the slabs with a disk sander. If the slabs show any deposit of fatty and greasy substances produced by a metal form, for example, clean them off with thinner.

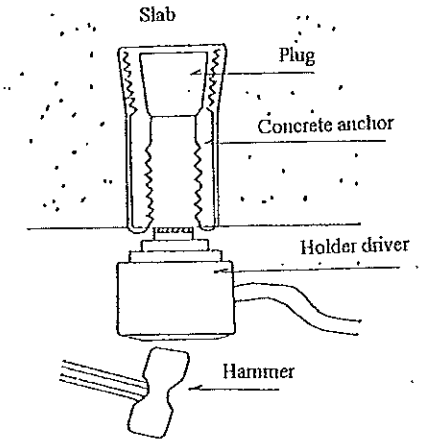
4. STEEL PLATE INSTALLATION

(1) Mark off such positions on the underside of the slabs as those where the steel plates and anchors are to be installed.
(2) Following the marking and using such tools as a hammer drill, bore holes of depths that match the length of the concrete anchors into the slabs at right angles to the slab surface. Keep the boring depth constant.
(3) Drive in the concrete anchors with a holder driver, or a similar tool. The driving depth shall be as specified and the standard pull-out strength at least 1 ton.
(4) Mount the steel plates onto the underside of the slabs and secure them by tightening the mounting bolts. During this operation, insert spacers between the slab and steel plate to secure the predetermined injection thickness.
(5) Measure the injection thickness (Clearance between the slab and steel plate).
(6) Parallel to installing the injection pipes and air pipes, seal such places as where the pipes have been mounted, the periphery of bolts and ends of steel plates.

(1) Using the design documents as the basis, clearly mark off the positions on the underside of the slab where steel plates are to be mounted and anchors are to be installed.
(2) Following the anchor-installing-position markings and using a hammer drill, or tapered jack drill, bore holes into the slabs at right angles to the slab surface. Keep the boring depth constant. (Fig. 3-2)
If, during boring, the drill has hit a reinforcing bar, shift the boring position by 2 to 3cm off the center of the previous hole, and start boring all over again.
(3) Use of concrete anchors shall be considered standard usage. After sttaching the plug to the forward end of the anchor, and applying a holder driver to its rear end, drive the anchor in with a hammer. (Fig. 3-3)



(Fig. 3-2)



(Fig. 3-3)

(4) On completion of anchor installation, mount the steel plates onto the underside of the slabs at the marked off positions. To support the steel plate, utilize a support ordinarily used for timbering. Secure the plates by means of Bolts. To enable the predetermined injection thickness to be secured, spacers should be glued onto the steel plates with SHO-BOND #101 in advance.

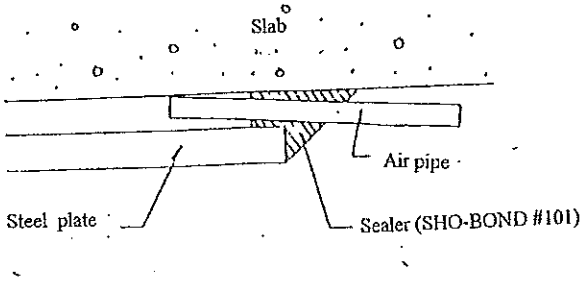
(5) Utilizing the plate ends as well as injection holes, measure the grout injection thickness with slide calipers.

(6) Mount air between the underside of the slab and steel plate. Carefully seal periphery of the air pipes, as shown in Fig. 3-4, so that the pipes will be able to withstand the injection pressure.

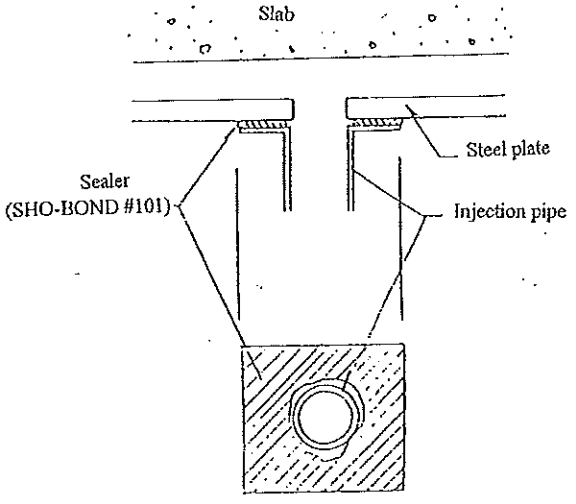
Finish the surface to a flat and even surface.

With SHO-BOND #101 applied to the washers, install the injection pipes into the injection holes provided in the steel plates. (Fig. 3-5)

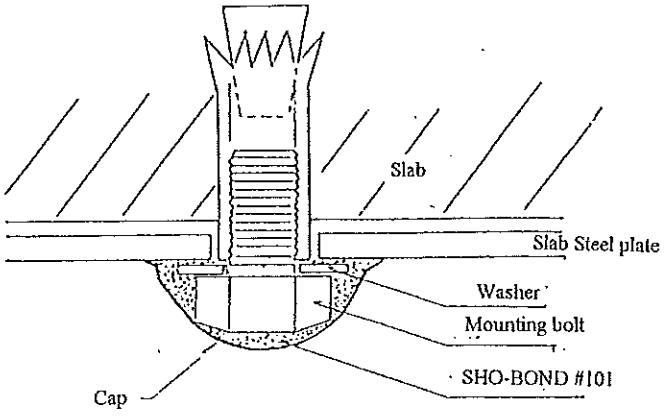
Install the caps onto the mounting bolts. First, fill SHO-BOND #101 into the cap. Then, turn the cap slowly and press it against the bolt body. After the bolts have been installed, remove the portion of SHO-BOND #101 that had oozed out around the cap to provide a neat appearance. (Fig. 3-6)



(Fig. 3-4)



(Fig. 3-5)



(Fig. 3-6)

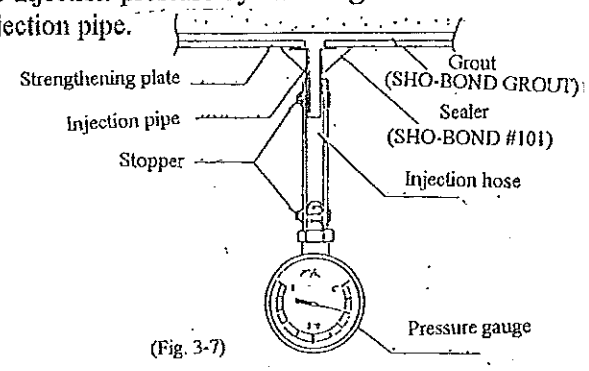
5. RESIN INJECTION

(1) Mixing of resin components should be performed, taking care to mix only a quantity can be used up within the pot life time.
(2) Grout should be injected at a constant pressure, starting from the lower-side plate end. Continue injection until confirming that grout has gushed out from the adjancent pipe. Attach the stopper to the pipe and move onto the next injection hole. This procedure is to be repeated for all consecutive injection pipes. The stopper of the last injection pipe should be attached while applying pressure (about 0.3kg/cm^2).

(1) Use a scale to batch the resin components. They should be mixed in an amount that could be used up within the pot life time. The mixing time shall be at least 60 seconds for machine-mixing, and at least 3 minutes for hand-mixing. Application should be started only after confirming that the components have been perfectly mixed.
(2) After curing the sealer, start grout injection. Start grout injection from the lower-side plate end. The injection pressure should be kept constant.
After confirming that grout has gushed out from the air pipe, seal that injection pip*1, and move on consecutively to the next injection port. The pipe for which injection has been completed should be tightly sealed with a stopper to prevent outflow of resin. The stopper for the last pipe should be applied while applying an injection pressure of approximately 0.2kg/cm^2.*2
Meanwhile, in parallel to injection work, the state of injection should be confirmed by hitting the plate with a hammer.
There are two types of grouting pumps - the foot-type end electric type. Selection of which to use should be decided so as to match the sepcific site conditions.

*1 Attach a vinyl bag to each air pipe. At the point grout gushed out into the bag, apply the stopper to the injection pipe.

*2 If, as a result of preliminary consultation, it has been decided that there is need to effect injection pressure control measure the injection pressure by attaching a pressure gauge as shown in Fig. 3-7 to the injection pipe.



(Fig. 3-7)

* Injection should be performed with the area covered with sheets (ordinaruly used for curing) to prevent the grout from dropping below the bridge and causing annoyance to third parties. Clear the area below the bridge of all objects (e.g., vehicles) that may suffer damage from construction. Be sure to move them from below the bridge before starting work.
* The number of days required for curing shall be at least one day in the summer, two days in the winter, and from one to two days in the spring and autumn.

6. FINISHING

(1) After completing curing of sealer, cut off the injection pipes with a sander, or the like, and finish the place from which the pipes were removed to a flat and even surface with the sander.
(2) Referring to the design documents, coat the plate surface.

(1) After curing the grout for the specified time, cut off the injection pipes and air pipes, using a sander, cutter, or the like. Finish all surface irregularities of the sealer to a flat and even surface. Use a sander for finishing.
(2) Based on the specifications provided in the design documents, coat the surface of the steel plates. Prior to coat application, be sure to remove all fatty and greasy matter, dust and dirt from the coating surface.

7. CLEARANCE WORK

(1) Upon completion of work, immediately clear the site of all materials, machinery and tools. All debris that had generated in the site during construction should be cleared away as well.

(1) After completing work, receive inspection of empty cans. With the empty cans arranged as classified by method and product for each type work, inspection shall be conducted with the owner attending. The empty cans should be disposed of immediately after inspection has been completed.
Remnant materials as well as machinery and tolls should be put in order, or transferred to a specific location in the site, and then immediately cleared away. The site should be cleaned of all debris that had generated during construction.
Places on existing structures that have been dirtied, or stained should be perferctly cleaned.

CONSTRUCTION CONTROL

1. AS-BUILT CONTROL

(1) Dimensional Control
For each construction area, measure the steel plate bonded area.
* Injection thickness
Confirm the actual injection amount by inspecting the number of empty grout cans.

(2) Workmanship Control
Control should be effected on the state of plate deflection (to obtain an glue-line thickness), the state of the finishing seal, finishing coating, etc. to ensure excellent workmanship.

(1) For each location of construction, measure the plate-bonded area, and draw up an Output Calculation Sheet and As-built Quantities Table.
* The injection thickness can be confirmed with slide calipers, utilizing the injection hole in the steel plates.
* Such matter regarding as-built control as the measuring point positions, units of measurement method and the method of preparing contro; drawings should be thoroughly discussed and decided upon at the stage a consultation meeting on construction is being held. All metters decided upon should be fully put into practice.

2. QUALITY CONTROL

(1) Before starting work, submit such quality certificates as test performance sheets on products, and receive approval on the materils to be used.
(2) Conduct tests on test pieces sampled at the stage of site construction.

(1) Before starting work (i.e., at the stage of holding a consultation meeting on construction), submit, for approval, such quality control data as test performance sheets and quality certificates obtained during the shop fabrication process for the materials to be used.
- o Steel plates ----- Quality certificates and test performance sheets (Mill Sheets)
- o SB #101 ----- Quality certificates and test performance sheets (Mill Sheets)
- o SB GROUT ----- Quality certificates and test performance sheets (Mill Sheets)
- o Others ----- Quality certificates and test performance sheets (Mill Sheets)

* Before starting work (i.e., at the stage of delivering the materials to the site), receive a materials inspection for each different product.

(2) At the stage of site construction, sample test pieces in accordance with the design documents. Prepare test performance sheets (quality control data) for submittance.
* Such matters relating to quality control as the type, method, frequency of tests to be conducted, and the method of preparing control charts should be thoroughly discussed and decided upon at the stage a consultation meeting on construction is being held. Matters thus decided upon shall be fully put into practice.

3. PHOTOGRAPHIC CONTROL

(1) Photographs showing the circumstances of work
For the work as a whole and each work process, take circumstantial photographs showing work that is being carried out for each type of work.
(2) As-built control photographs
The photographs shall be those taken for dimensional confirmation including those showing measurement of the construction area, and other as-built photographs.
(3) Quality control photographs
The photographs shall be taken during the process of executing work, and shall concern such quality control as material tests.

(1) Photographs showing the circumstances of work should, in principle, be taken from the same direction. To permit comparison between "before" and "after" construction, photographs showing the site before construction and on completion of work should be taken from the same position. The frequency at which photographs are to be taken should be decided after consulting the matter fully with the owner and main contractor. Shown below are the standard processes to be photographed.

1. Before construction
2. Plate fabrication
3. Substrate preparation
4. Cleaning of underside of slab (using thinner)
5. Completion of substrate
6. Marking-off
7. Boring
8. Driving-in of anchor
9. Steel plate installation (State of support)
10. Steel plate installation (Tightening of bolts)
11. Installation of injection pipes and air pipes
12. Completion of injection pipe and air pipe installation
13. Sealing
14. Completion of sealing
15. Resin injection (Showing how pump is used)
16. Resin injection (Showing injection confirmation by use of wooden hammer)
17. Completion of injection (Photograph the state of resin accumulation in the vinyl bag attached to the air pipe)
18. Finished state
19. Coating work (intercoat application)
20. Coating work (Completion of intercoat application)
21. Coating work (top coat application)
22. Completion of construction
23. Completion

MATERIALS, MACHINERY AND TOOLS TO BE USED

1. Material To Be Used

(1) Main Materials
Main materials to be delivered to the site for use in the SHO-BOND STEEL PLATE BONDING METHOD may include materials other than those of the design product descriptions to comply with the specific site conditions.
Conduct estimation on the materials prior to delivering them to the site.

(2) Auxiliary Material
Such auxiliary materials for washing as thinner and waste cloth should be delivered in more-than-enough quantities.

(1) After confirming the required construction quantity by a comfriming the required construction quantity by a preliminary survey, materials are to be procured and delivered to the site, by referring to the estimated quantities. Adjustment that must be made in terms of main materials due to changes in design should be confirmed at an early stage, to ensure procurement of materials ahead of time.
Listed below are the main materials used in the SHO-BOND STEEL PLATE BONDING METHOD.

o SHO-BOND #101	-----	For sealing
o SHO-BOND GROUT	-----	For injection
o Steel plates	-----	For slab strengthening
o Concrete anchors (w/bolts & nuts)	-----	For plate installation
o Injection pipes and air pipes	-----	For injection and venting of air
o Bolt caps	-----	For sealing
o Grouting caps	-----	For injection and venting of air
o Spacers	-----	For slab strengthening

(2) The required auxiliary materials are as listed below.

o SHO-BOND THINNER	-----	For washing
o Waste cloth	-----	For washing

2. Machinery and Tools To Be Used

(1) Machinery

Necessary machinery should be procured, after confirming such matters as the construction conditions at the site at the stage of the preliminary survey, and studying the type, capacity, quantity, etc. of the machines needed.

(2) Tools

Necessary tools, too, should be procured after checking what kind of tools are required for each type of work.

(1) Such matters as the type, capacity, quantity, etc. of the machinery to be used should be decided upon at the stage of the preliminary survey so as the match the construction conditions, etc.

Before commencing work, conduct operation tests to check the machines for disorders, fuel, and so forth.

Shown below are the machinery used in the SHO-BOND STEEL PLATE BONDING METHOD.

o Generator	-----	Electric source for construction machinery and tools
o Hammer drill	-----	For boring anchor driving holes
o Hand-Mixer	-----	For resin agitation
o Jet Heater	-----	For heated curing
o Disc-grinder	-----	For slab substrate preparation
o Foot pump	-----	For grout injection
o Goggles	-----	Used when applying Disc-grinder for slab substrate preparation
o Hammer drill and auger	-----	For boring holes in slab
o Hammer and chisel	-----	For breaking concrete
o Wrench and ratchet	-----	To tighten bolts
o Brush, metal spatula and rubber spatula	-----	For coating and sealing
o Ink bottle	-----	For inking
o Steel tape measure and scale	-----	For measurements
o Sand paper	-----	For substrate preparation
o Punch	-----	For punching holes into steel plates
o Convex rule	-----	For measurements

(2) As-built Control Photographs

1. Measurement of area (or volume) of substrate preparation (or patching)
2. Measurement of steel plate-bonding area
3. Measurement of injection thickness
4. Measurement of injection pressure (as decided by consultation)
5. Measurement of coating thickness
6. Inspection of empty cans
7. Other photographs relating to as-built control as requested in the design documents.

(3) Quality Control Photographs

1. Inspection of materials
2. Mixing and agitation of resins (calculation and agitation)
3. Sampling of test pieces
4. State of test and results
5. Other photographs relating to quality control as requested in the design documents

* Matters concerning photographic control such as the type of photograph (colour, or black-and-white), photographing method, places to be photographed (and the nember of photographs to be taken), and how to arrange in other should be thoroughly discussed and decided upon at the stage of holding a consultation meeting on construction. Matters thus decided should be fully put into practice.
Meanwhile, a Photograph Control Check List should be prepared for use at the site. Efforts should be made to avoide wasteful photographing as well as careless omission of photographs that should have been taken.