

Construction of corrugated steel plate

1 Overview

Corrugated Steel Plate structure is constructed with sheets of 3H~9H(1555~4105mm)'s corrugated section, and the kinds of each sheets are reflected by its economic, production, construction aspects.

Constructed many structures domestic, until today, and corrugated steel plate structure constructing methods varied by the conditions such as Barrel Plate, Reversed Rib, CBS Composite Beam System and introduce the methods as below.

2 Barrel corrugated steel Plate construction

Barrel corrugated steel Plate construction doesn't need renewal and have been adjusted mostly. The construction is same to the 400 x 150 profile plate and 150 x 50 profile plate.

2.1 Installing fixed channel

By the design, conclude anchor to fixed channel on basis. L shaped anchor connects the basis, and fixed channel supports the basic upper of the corrugated steel Plate.



picture 2.1.1 Installing fixed channel

Like the picture 2.1.1, After distribution of steels are over, place the fixed channel. As set on the design, check the expected coating thickness and the steel distribution, fix by welding the connecting line by connecting L shaped anchor to steel rod. When installing channel, examine the plan of basic upper after pouring concrete, and install by the angle of surface shape and fixed channel place.



picture 2.1.2 Installing fixed channel



picture 2.1.3 Fixing L shape anchor



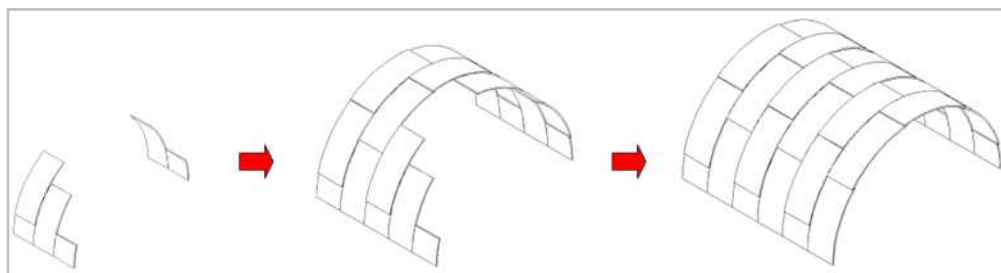
picture 2.1.4 Direction of channel



picture 2.1.5 distance of anchor hole

Installation of fixed channel is same to fixing steel plate beforehand, so construct by the detail of channel of steel plate. Like in picture 2.1.4, channel has extension direction to the same line, and L shape anchor is concluded by distance of 400mm. Max size of fixed channel is 3600mm, considering the transportation and construction. When bigger, connection like in picture 2.1.5 will occur. Set the installation of fixed channel considering the 400mm distance.

2.2 construction of corrugated steel plate.



picture 2.2.1 outline of construction of corrugated steel plate.

When the installation of fixed channel is over, check the locations of bolt hole of channel and start constructing steel plate. Like picture 2.2.1, pre construct the steel plate welded to channel, and construct both sides, haunch part, and then Crown part. Set a standard to one ring construction and repeat the method.



picture 2.2.2 pre conclusion of steel plate



picture 2.2.3 connecting plates to channel

Picture 2.2.1, in order to shorten construction time, pre concludes initial ring for the standard of the following conclusion. it is a normal method to connect steel plate to fixed channel and all the way from both sides to upper CROWN part. Yet when having space enough to construct, do as the picture 2.2.2. Picture 2.2.3 is the process of placing initial ring which is the standard, to the fixed channel. Start constructing from the upper part of scene by using crane.



picture 2.2.4 conclusion of channel to plate



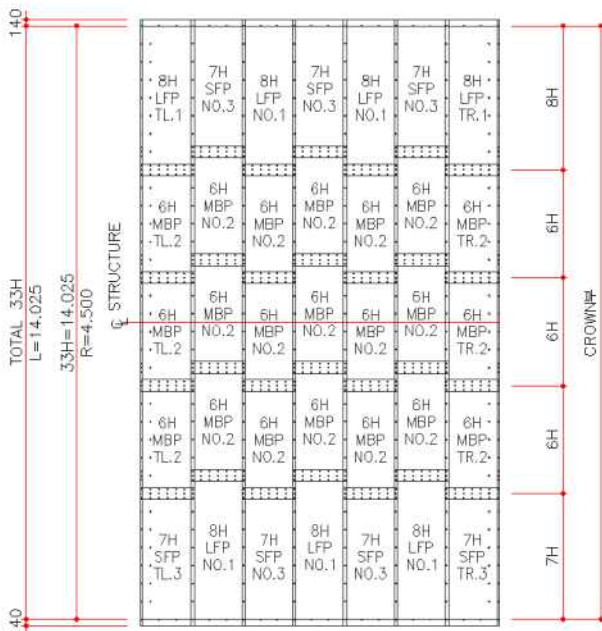
picture 2.2.5 Installation direction

Picture 2.2.4, uses Impact Wrench to conclude fixed channel to steel plate, and check whether the channel's bolt hole and steel plate's bolt hole are welded perfectly, the distance being 400mm. construction of corrugated steel plate is made in the upper to lower direction of structure, same to tunnels. Assuming the water is flowing, steel plates pile gradually from the upper direction to the lower, so inner flow of water is hard to invade on the outer side of steel plate structure, eventually forms a covering of piling up steel plate's shape.



picture 2.2.6 construction of corrugated steel plate

There are other methods considering corrugated steel plate structure placements and conditions, yet 2.2.6 is the basic way of construction. After construction the side where the fixed channel is contacted, construct shoulder part, which is the haunch. After, construct the CROWN part which is the peak and set the shape.



connecting part connection of steel plate is circumference and structure extension direction, and less than 3 sheets of piling is recommended. when 4 or more is plied up the connecting part, gap may occur and can be fragile to pressure during construction, being vulnerable to deformations. Like the picture beside, 3 sheets of piling is the standard, and in terms of structure extension direction, each connecting part is arranged by passing. this is initiated for the prevention of destruction by buckling made by elongation of connecting parts.



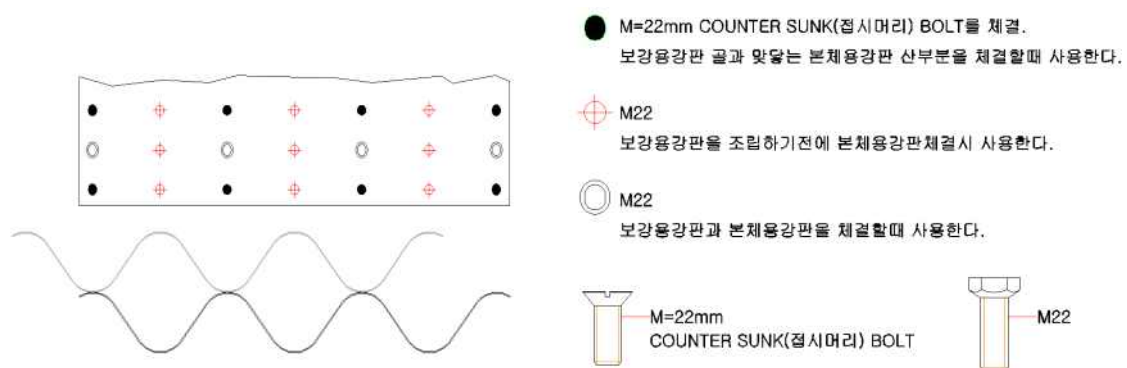
corrugated steel plate structures above are different in sizes and shapes yet, it is constructed by the same methods presented above and it may differ by the condition of the location.

3 Reversed RIB construction

RIB enforcement practiced when is corrugated steel plate structure's hardness is lacking for high rising ground or long space. connecting part strength does not increase by the enforcement.



When enforcing steel plate, it can be constructed to Bow and Arch forms, and especially in Box forms, used in enforcing peak and shoulder part by the concentration of moment. Like the picture above, additional concrete is not filled in midair made by base steel plate and subsiding steel plate so, the construction time is short for not needing curing period and constructed in basic production process.

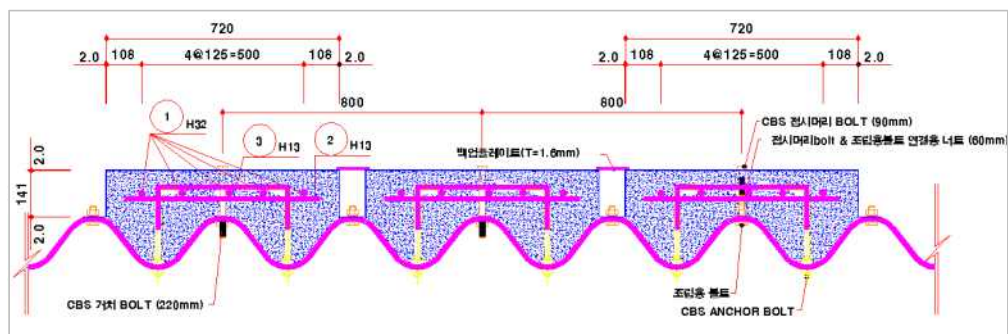


The above picture is the detail of the contacting part of base and subsiding steel plates, and by constructing using plate head bolt for sub siding steel plate, construct the plate headed bolt on the mountain part of the base steel plate for it faces in symmetrical way.



4 CBS reinforcement construction

Corrugated steel plate structures with more than 20M of space considering high rising ground, **declining earth pressure** other than those unable to adjust RIB, shall have CBS enforcement for vertical wise sub-materials. CBS increases connecting part strength and secures harness by Composite functioning to the corrugated steel plate structure. Now, spaces up to 25~26m are adjusted, and shows great adjustments by securing 6 lanes round trip.



picture 4.1 Detail of CBS

4.1 distribution of rods on outer basic corrugated steel plate

By the design blueprint, construct L=285MM L shaped anchors used in CBS to the designated holes and distribute the rods as the picture below.



picture 4.1.1 CBS anchor installment

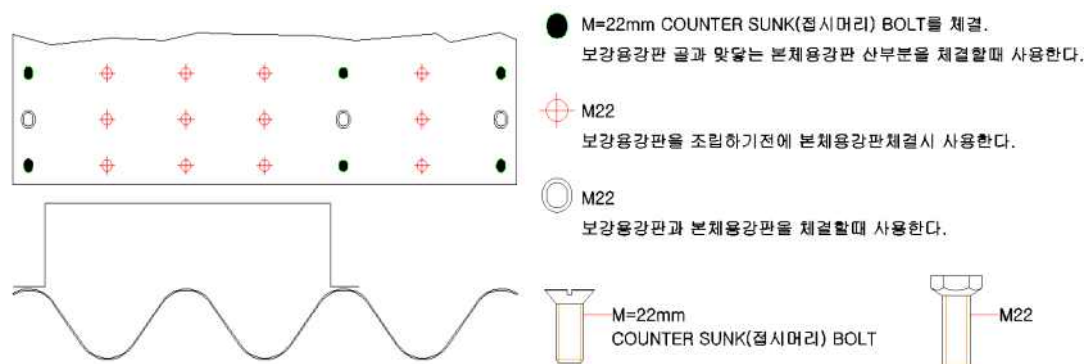


picture 4.1.2 rods after anchor installment.




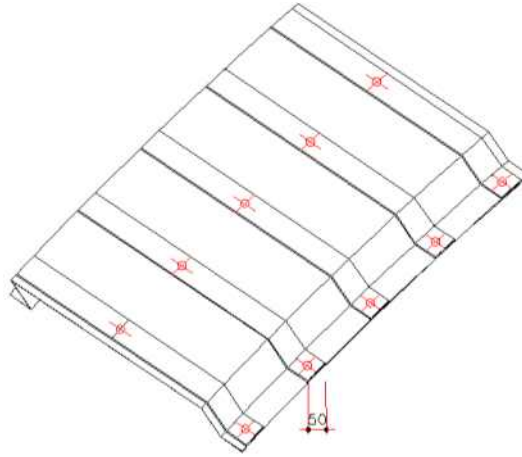
picture 4.1.3 CBS rod distribution

4.2 Conclusion of outer hard materials on basic steel plate



picture 4.2 Detail of CBS welded bolt on basic steel plate connecting part

On basic corrugated steel plate structure connecting part, conclude CBS outer hard material by using plate headed bolt and basic conclusion bolt. outer hard material uses 1.6mm and 2.0mm and it shall be chosen by the conditions to prevent fulling of hard materials when pouring and consider the RISE of basic steel plate structure. Also, conclude  shaped supporting belt to the left side of outer within 425~85MM distance.



CBS supporting belt welding.



picture 4.2.1 enforcing and concluding CBS outer

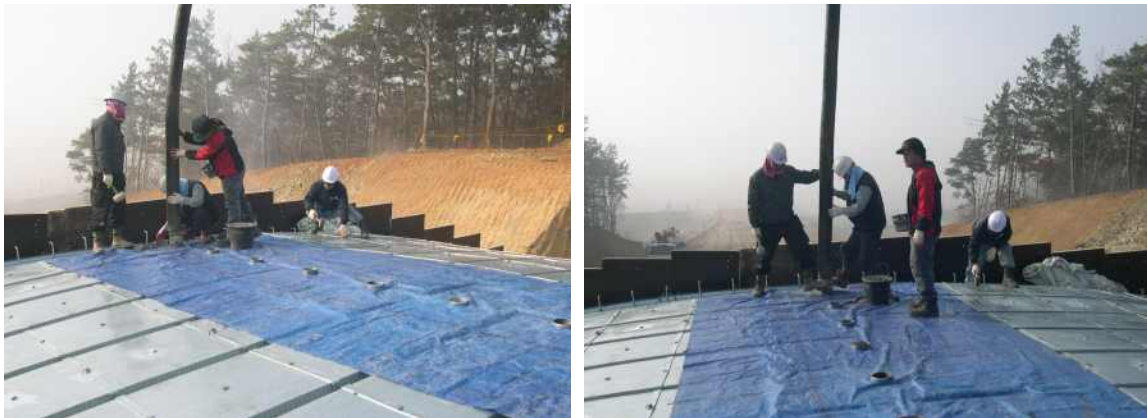
In order to prevent bleeding and separation of materials in filling concrete, practice partial pouring by 1 and 2 times, and the picture 4.2.1 is constructing of **form** to the hunch lever of structure.



picture 4.2.2 CBS 1st Partial pouring



picture 4.2.3 CBS 2nd Partial pouring



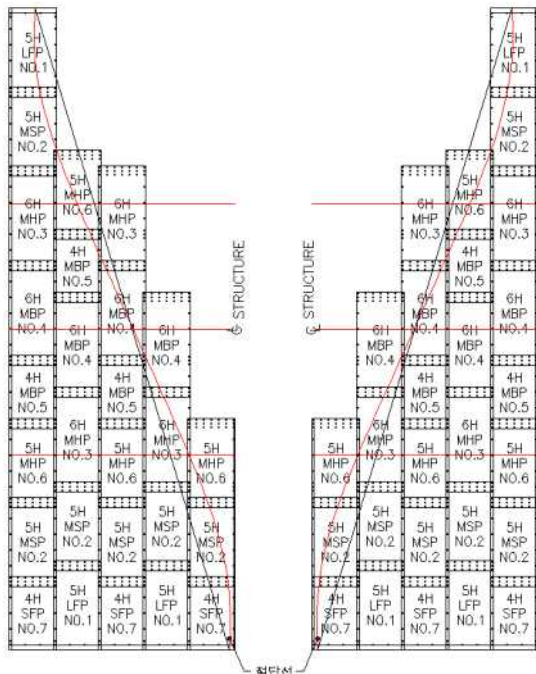
picture 4.2.4 CBS 1st Partial pouring (concrete released to GROUT FITTING HOLE)

After 1st concrete pouring is over, construct remaining CBS outer. This process has no relations to the 1st concrete **curing** so, it can be practiced right away. CBS 1st Partial pouring, shall minimize the bleeding of concrete by using vibrators, and allows managing easy for material fall out can be seen with bear eyes. When hard material outer is done, Like 4.2.4, weld the concrete pump to GROUT FITTING HOLE of $\varnothing 125$ at the peak, and pour remaining concrete by pressing.

5

corrugated steel plate structure's elbow.

Like explained in corrugated steel plate construction, corrugated steel plate structure has straight form to the extension way, so elbowing of the steel plate is required for adjustment to lanes.



The picture beside show corrugated steel plate squares having the same angle, and after treating SKEW line, which is the square of red cutting line connect the two structures by connecting to cutting lines. By the scene condition, use welding or hard material elbow, and comparatively spaced structures like the picture below, use hard material elbow.



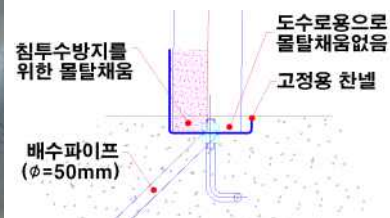
When using hard material elbow, weld one side of the corrugated steel plate and elbow hard material and then set a standard, bring the other side corrugated steel plate and construct. Since it's produced in factory, it shall be pre-constructed before production, or constructed to minimize the difference occurring on scene with measuring the opposing side after one side of steel plate and elbow is made. Strict examination of water proof on both sides of corrugated steel plates are mandatory.

6 corrugated steel plate structure water resistance

corrugated steel plate structure is formed by constructing each SEG, so water resistance work is additionally needed, especially on tunnels. The **production process** is adjusted over the entire structure, and the following is the sequence and method.

- ① non compressive concrete Mortar filling on area behind fixed channel.
- ② PRIMER distribution for urethane shell adhesion
- ③ distribution of urethane shell silent
- ④ unexposed distribution of urethane shell
- ⑤ connecting part bolt area urethane shell silent + water proof cap
- ⑥ corrugated steel plate piling area urethane shell silent + water proof cap

6.1 non compressive concrete Mortar filling on area behind fixed channel.



When backfilling is done, water can invade in the fixed channel and corrugated steel plate welding part by rain on the ground surface, and within. non compressive concrete Mortar filling on area behind fixed channel is made for protecting leaking water, and The front part of the channel shall not have non compressive concrete Mortar filling, and have water entering tunnel.

Construct drainage pipes by regular distance in the bottom part of the channel considering the condition of construction for high population rated areas. By doing this it prevents water invasion through drainage pipe under the tunnel as the idea of water canal.

6.2 PRIMER distribution for urethane shell adhesion



Upper part of non compressive concrete Mortar filling on area behind fixed channel shall have distribution of adhesive PRIMER for additional water proof. There is need in changing the character same to the one before urethane shell water proof process, of concrete character.

6.3 distribution of urethane shell silent



non compressive Mortar filling and fixed channel are different materials of character, so after distributing PRIMER, practice 1st detail water proof to the contacting line with urethane shell silent

6.4 unexposed Distribution of Urethane shell



After by using urethane shell silent, distributing to the steel plate and border of non compressive mortar, initiate unexposed distribution of urethane shell and have 2nd water proof

to the Invading water .

6.5 connecting part bolt area urethane shell silent + water proof



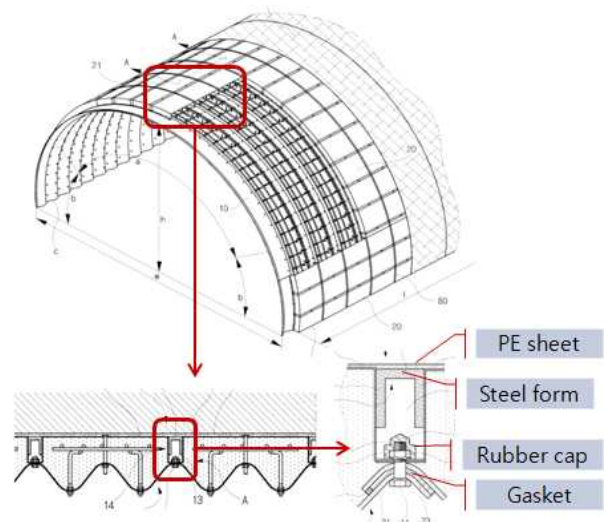
The process is to prevent leakage in the space of construction bolt and corrugated steel plate welding part, by inserting urethane shell silent in the rubber cap, and hardening it by covering it to the bolt body and nut, all for the water proof.

6.6 corrugated steel plate piling area urethane shell silent water proof



Leakage is likely to occur in space of corrugated steel plate piling part, so void be filled with rubber gasket and urethane shell silent distribution.

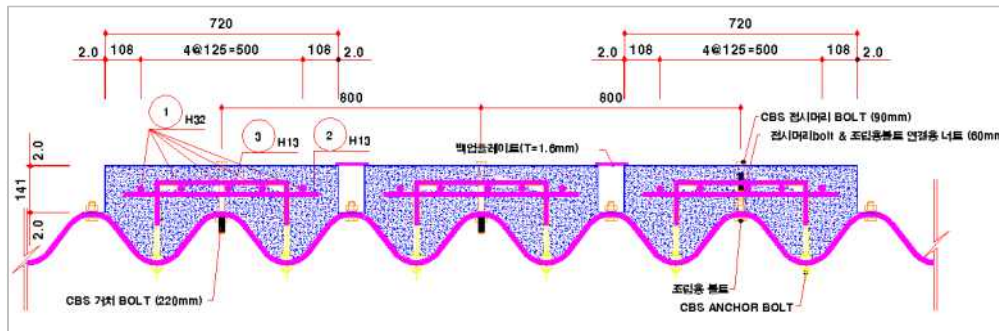
6.7 CBS water proof



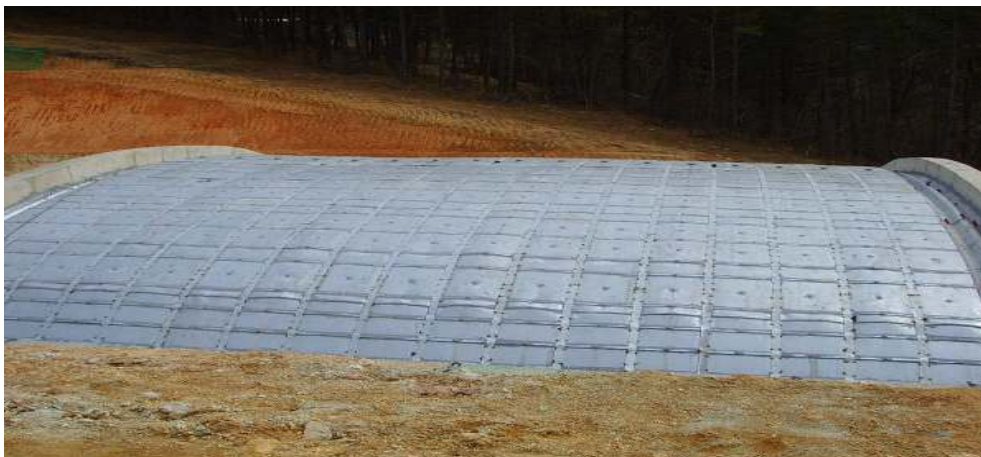
Plain surface of CBS steel form enables polyethylene sheet to cover the structure. Four layers (protection steps) of waterproofing cover. 1) PE sheet 2) steel form 3) rubber cap 4) gasket




After CBS construction, initiate urethane silent water proof to welding part of bolt between supporting plate and supporting belt. After that, initiate urethane silent water proof blocking the GROUT FITTING HOLE part which unioned CBS peak part concrete pouring pump.



CBS detail



CBS - back up plate construction

The picture of CBS detail (when enforced 100%) shows that when filling back up plate between  gap of strips by welding, corrugated steel plate and CBS unevenness shall not show upon the supporting material upper surface. Since the upper top of structure is flat, coating weld on the upper top of structure by using PE-SHEET, used in basic tunnel structures.



AP PRIMER distribution



PE-SHEET water proof on upper side of
CBS

Before PE-SHEET coating the upper structure, use AP PRIMER to increase adhesion of welding side. This allows PE-SHEET and the character of upper steel plate to become similar in character in making easier welding construction to be practiced. Use the following PE-SHEET for finishing water proof on the upper structure.