MULTICONSULT

Avd. NOTEBY

25 JAN 2005

Smidt & Ingebrigtsen AS
Att.: Hilmar Lilleøren
Postboks 181 Nesttun

5852 BERGEN

Deres ref.: Vår ref.: N400839/ads Bergen, 24. januar 2005

Matre Havbruksstasjon
Spuntbeskrivelse - spuntprofil

Vi viser til kommentarer fra Statsbygg via E-post angående post 2.02.3 i beskrivelsen av spuntarbeider. Undertegnede med 25-års erfaring finner påstanden om "kompetansebrist" såpass alvorlig at vi finner grunn til å tilbakevise dette.

Påstandene tilbakevises i følgende punkter:

1. Leverandørene av spunt opererer både med kaldvalset og varmvalset spunt. Det er derfor på sin plass å nevne dette. Se for øvrig vedlegg.
2. Internasjonalt blir betegnelsene "U-sections" og "Z-sections" brukt i utstrakt grad. Se vedlegg. Dette er en entydig betegnelse på geometrien av spuntnålene. Det er normalt at tabellert motstandsmoment blir redusert for U-spunt.
3. Når det gjelder betegnelsen på motstandsmomentet, W_y, så er det en definisjonssak hva man benytter som x- eller y- akse. Hadde det bare stått W hadde ingen reagert, og det er meningsløst å snakke om motstandsmoment i den andre retningen.En entreprenør vil aldri være i tvil om denne betegnelsen. Vi beklager likevel at enheten cm^3 ble brukt i stedet for cm^3/m. Dette er heller ikke misforstått av entreprenør.
4. Grunnen til at nålebredde ble oppgitt sammen med motstandsmoment var at det var strenge krav til geomeri, og for å få konstruksjonen på tegning nr.551 til å henge i hop var det nødvendig med angitt nålebredde. Derfor er spunttypen PU20 eller tilsvarende oppgitt på tegning da denne tilfredsstiller begge krav. Vi kan derfor ikke se at det er avvik mellom tekst og tegning.

Vi forventer svar fra oppdragsgiver på dette med det første.

Vennlig hilsen
for MULTICONSULT AS

Arne D. Stordal

Kontrollert av:

Vedlegg: Utskrift fra Internett

Kopi: Statsbygg v/Rolf Jullum

T.T brev fra Multiconsult datert 24.01.05

INTRODUCTION TO STEEL SHEET PILING

Introduction to Steel Sheet Piling :

Steel sheet piles - Background

Steel sheet piles have been used in the construction industry since the beginning of the 20th century. The first steel sheet piles were simple steel plates on which plates were riveted to provide an 'interlocking' joint. This continuity made it possible for a wall to retain soils and to a lesser extent, water, thus replacing the use of wooden sheet piles.

The limits of such rudimentary steel sheet piles lead the industry to seek a more economic and effective way to connect the sheets. One of the first sheet piles manufactured was the 'Lackawana', a straight web (also called 'flat') sheet pile used in the construction of circular cells and diaphragm cells early in the 1900's.

Around the same time, a European engineer developed the Larssen interlock that is widely used today.

Although sheet pile manufacturing started at about the same period in the US and in Europe during the 20th century, the evolution of the shapes and interlocks followed different paths.

a. Interlocks:
   The 'Larssen' interlock was preferred for U-shape or Z-shape sheet pile manufactured in Europe whereas the 'ball and socket' interlock was adopted by US manufacturers.
b. Sheet Pile Shape:
   US manufacturers limit production to Z-shapes and flat shapes. In Europe, preference is growing for Z-shapes mainly because of new code provisions (Eurocode) that apply strength reduction factors to paired U-shape to take account of possible loss of shear transfer across the interlocks.

Sheet Pile Classification

1. **By manufacturing process**

· **Hot rolled sheet piles**
are produced in a steel mill from liquid steel that is continuously cast into a semi finished blank. The blank is then passed through rolls until a finished shape is produced. The Hot-rolled process produces a homogeneous metallurgical structure giving uniform properties throughout the section. The rolling process includes the formation of a geometrically defined interlock. The hot-rolled process also gives the manufacturer flexibility to vary section thickness across the section to enhance performance criteria such as strength, durability and drivability.

· **Cold formed sheet piles**
are produced from coil by cold rolling the coil into a sheet pile shape. Standard coil sizes are used giving uniform thickness throughout but also limiting the section thickness to about half an inch. The limitation on coil thickness is a limiting factor in section capacity development. Typically the maximum section modulus of cold formed sheet piles is around 46.5 ins^3/ft. The interlock is formed by rolling the coil into the desired shape. The interlock produced is quite different from the hot rolled interlock and tends to be a looser connection.

Both Hot-rolled and Cold-formed sheet piles are similar but have different performance characteristics due to the production process. Typically Cold formed sheet piles occupy the lighter end of the sheet piling range and are ideally suited to applications where loads are relatively small.

2. **By mode of use**

- **Permanent**

Service life designed into the application can be more than 100 years.

- **Temporary**
  service life from weeks to a number of years

3. **By Sheet Pile Type**

i. Standard sheet pile shapes (U or Z)

ii. Flat Web sheet piles

iii. Combined wall systems

i. Standard sheet pile shapes (U or Z shape)
have a section modulus of up to 5,000cm^3/m (90in^3/ft) and are used for retaining walls and wharfs up to about 10m (33 ft) high with one support level. Cantilevered walls, strutted trenches and wharfs are sheet pile applications most engineers are very familiar with. In the US, Z-sections are prevalent.

There are 2 main types of standard hot-rolled sheet piles, Z-sections and U-sections. In the US, over 98% of standard sheet piles installed are Z-sections.

Sheet Pile Types

AZ sections (Click here for the range of AZ sheet piles)

The first sheet pile was rolled by Arbed in 1911. The AZ sections (18 sizes based on 5 geometries and 3 different thickness per geometry) were introduced in 1990 to meet the need for more efficient and stronger sheet piles. Section modulus S_x ranges from 1,200cm^3/m (22.3in^3/ft) to 5,015cm^3/m (93.3in^3/ft).

The additional width of AZ significantly cuts construction time by reducing the number of piles to be pitched and driven. In addition where water seepage must be controlled having less interlocks is a great advantage.

The interlock swing of the precision Larsen interlock is 5°. Maximum rolling lengths are 31.0m (101.7')

Skyline Steel LLC stocks the range of AZ sections at strategic locations throughout the US.

PZ sections: (Click here for the range of PZ sections)

PZ sections are manufactured in the US by 2 steel mills. Skyline Steel LLC supplies PZ sections from Nucor, Blytheville, AR. The PZ range produced in the US comprises four section sizes with section modulus from 973cm^3/m (18.1in^3/ft) to 3260 cm^3/m (60.7 ins^3/ft). The PZ range is favored by many contractors for temporary applications because of the 'ball & socket' interlock and favorable interlock swing of 10^0. The PZ sections are made in the US and meet the requirements of domestic only supply on certain public sector work. Maximum rolling lengths are 25.9m (85.0')

Skyline Steel LLC stocks the range of PZ sections at strategic locations throughout the US.

CZ and CS sections: (Click here for the range of CZ, CL and CS sections)

CZ and CS are Cold-rolled Z sections manufactured by Casteel, a Skyline Steel LLC subsidiary in Girard, OH. The coils required for the production are supplied from domestic mills. Production comprises 15different sections. The section modulus varies from 341cm^3/m (6.34in^3/ft) to 2,200cm^3/m (40.9in^3/ft). Those sections are obtained from 3 different shapes with a variation of the thickness of the coils. The notional interlock swing of the cold rolled sections is 10°.

ii. Flat web sheet piles:

Flat web sheet piles are used in circular cells and diaphragm walls. These structures act as gravity structures where the mass of soil contained within the cell provides the structural stability and load carrying capacity.

The horizontal pressure inside the cells generates high tension forces in the interlocks. Thus the main characteristic of a flat sheet pile is the thickness and the interlock strength R_u. Their main use is for deep cofferdams, especially in rivers, for the construction of locks and dams or bridge piers. A different field of application is in port construction, for wharfs, jetties and breakwaters.

A unique feature of cellular structures is that the sheet piles don't need deep penetration for the structure's stability.

Although the sections look similar, the interlocks from different producers are not compatible. Circular cells are connected by intermediate arcs. Isolated cells are rare. Junction piles have an angle of 30° to 45°; however in the US, for cells with small diameters, T-piles with 90° angles have been used. Most design engineers in the US are still specifying bolted junction piles, but outside the US, almost all junction piles are welded, which is more economical and is superior if the welding is done according to the standards. When the radius of the cell / arc is too small, pre-bent piles are needed. A maximum bend of about 12° per pile bent is recommended.

Installation

The construction of cells is a specialist procedure. An elaborate template is needed to support and align the cell. Compared to construction of a standard sheet pile wall or even an HZ wall cellular construction is much more complex.

AS500 sections:

Manufactured by Arbed in Luxembourg, there are 5 different thicknesses available, ranging from 9.5mm (0.375") to 12.7mm (1/2").

Interlock strength (according to EN10248) of up to 5,500kN/m (31.4k/in) is available, depending on the thickness of the section and the steel grade. Nominal width is 500mm (19.69").

Maximum rolling lengths are 31.0m (101.7').

Interlock swing of 4.5°, and 4.0° for sheets longer than 20m (65.6'). The minimum diameter of a cell without bent piles is 12.7m (41.7'), and 14.3m (46.9') respectively.

(Click here for the range of AS sections)

PS sections:

Supplied from Nucor, these domestic flat sheets are available in 2 thickness, 0.4" and 0.5".

Interlock strength up to 3500kN/m (24.0k/in).

Width of the sheets is 500mm (19.69").

The interlock swing, unlike the AS500, is 10° for lengths up to 70'. Thus, the minimum diameter of a cell without bent piles is 5.7m (18.8').

(Click here for the range of PS sections)

iii. Combined Wall Systems

are mainly used in deep excavations, in deep wharfs (deep dredge levels) and in retaining structures where deflection is restricted. Section modulus of up to 30,000cm^3/m (560in^3/ft) can be achieved. These systems are preferred when hard driving is encountered. There are three types of combined wall.

HZ Combi-wall system
was introduced by Arbed in 1972. In 1997 the AZ sections replaced the intermediary BZ sections. The HZ king pile is rolled with a 'bulb' at the end of the flanges on which a connector will be threaded. This mechanical connection is the main difference between the HZ system and any other composed system where connectors are welded on the king piles. Laboratory tests have proven the reliability of the connection of the HZ systems even under very high loading.

Tube - sheet pile walls
have special connectors welded on both sides in order to connect the intermediary sheet piles. By choosing the adequate diameter and thickness, very high moment of inertia and section moduli can be achieved. Spiral weld pipes are most common in tube wall applications and foundation applications.

Box piles
have been widely used in Europe and the Far East. They consist of two sheet piles (or two pairs of sheets) welded together to form a box giving a very high inertia in both primary axis. Alternatively, by welding plates in between the front and back sheets, the inertia in the wall axis can be increased as required by design. These box piles are connected to intermediary sheet piles through the original interlocks of the sheets, without welding.

Combined wall systems: Detail

Combined wall systems are composed of 2 different sections: a ***king pile***, which is a stiff section (HZ or pipe pile) and an ***intermediary sheet pile***, an AZ section. In most cases the AZ section simply transmits the horizontal pressure to the king pile. The deflection of both sections is assumed to be the same. The length of the intermediary AZ sheet pile is usually shorter than the HZ king pile, varying from about 60% to 100% of the length of the king pile. The tip elevation of the AZ section is determined in design by the zero-pressure elevation minus about 2m (7') for security, depending on the soil characteristics. The king piles, are often used to carry substantial vertical loads (from crane rails, etc).

HZ/AZ systems. (Click here for the range of HZ/AZ combinations)

The HZ system was introduced by Arbed in 1997 and consists of 160 different combinations. The HZ is an extra wide wide-flange section made specifically for this application (460mm, 18.11"). The additional width of the HZ/AZ system improves installation efficiency and reduces construction cost.

Intermediary AZ sheet piles are usually light sections, AZ28 being the heaviest to be recommended for this system.

There are 3 basic HZ sections; HZ 575, HZ 775 and HZ 975, each available in 4 different thickness.
A typical designation will look like HZ775C-14/AZ18, where the HZ77C is the beam, the 14 refers to one beam plus four connectors (1RZD and 1RZU on the front flange, 2RH on the backside of the HZ) and an intermediary AZ18.
The advantage of the HZ system is the component build where various combinations can be put together to meet design loading. Also the beams may be driven further than the intermediary sheet piles to reach deep founding layers.

Steel grades from Gr50 to Gr65, including ASTMA690 are available. The special connectors are also hot rolled and can be delivered in matching steel grades including S430GP (equivalent to ASTM A572. Gr.60) and A690Gr.60.

When RH connectors are present in the back (solution 14 and 26), their shorter length will be determined in order to match the maximum moments (unless deflection is governing the design criteria) plus a certain security length, say 1m to 2m (4' to 7') on both ends.

Maximum S_x is around 29,500cm^3/m (548in^3/ft) for a combination HZ975D-C23 (no AZ intermediary sheet piles).

Installation of HZ/AZ

The installation of the HZ/AZ system should follow certain simple rules including use of a two level template. Skyline Steel's technical department can assist specifiers and users with the design of the template.

Arcelor Long Commercial has developed software that will simplify the engineers' task to choose the right HZ/AZ system

(Click here for the range of HZ sections)

(Click here for the range of AZ sections)

(Click here to download HZ AZ Stresses software)

Pipe/AZ systems.

Pipe/AZ systems are an alternative high modulus system to the HZ/AZ system. Numerous combinations are possible. However A690 and high strength steel grades (Gr.55 and Gr.60) are not available.

The AZ is connected to the pipe by a connector (C9) welded to the pipe pile. The welding of this connector is critical to the function of the whole system. Advantages of the Pipe/AZ wall are that the pipe has the same inertia in both principle axis and that if an obstacle is encountered while driving the pipes it is easy to drill/loosen the soil inside the pipe and continue driving the pile to the required depth.

The pipe piles manufactured by Skyline Steel are helical welded. The pipe/AZ system is supplied with the C9 connectors welded in place.

Maximum section modulus is limited by the size and thickness of pipe that can be produced and driven. S_x; 20,000cm^3/m (372in^3/ft) is the maximum in the Skyline data sheets.

(Click here to calculate the section properties of a Pipe/AZ wall)

Installation Methods

(Click here to access the Sheet Pile Installation Manual in pdf format)

Applications

Sheet piles are suited to the following water and land based applications.

Traditional - Temporary

- Cofferdams and trenches
- Bank reinforcement in rivers and canals

Traditional - Permanent

- Wharfs, quay walls, berths, jetties, breakwaters
- Bank reinforcement in rivers and canals
- Vertical barriers such as dams and containment walls
- Bearing piles using box piles

Innovative - Permanent

- Bridge abutments / underground parking garages, basements
- Pollution Control Barriers to contain or exclude contaminants

Specific applications

Environmental Pollution Control

Sheet pile walls can be made watertight for use in cofferdams in a river or as pollution control barriers to contain or exclude contaminated soils. A number of systems are available including ROXAN™ and others that use either hydrophilic or bitumen based sealants to give extremely low levels of permeability. The interlocks of sheet piles can be welded with a quick deposit sealing weld to give an impermeable solution.

(Click here to access the Environmental publications.)

Structural Load Carrying Capacity

Steel sheet piles are not only capable of resisting horizontal pressures but also vertical loads through end-bearing and friction, just like any other bearing pile. Designers in many European countries have taken advantage of these features and used sheet piles to form the load carrying members in bridge structure abutments, basements and parking garage structures.

Headquarters: 8 Woodhollow Road, Parsippany, NJ 07054, Ph.973-428-6100, Fax 973-428-7399

Væhle, Olav

Fra: Larsen Stein (NO) [Stein.Larsen@ncc.no]
Sendt: 1. februar 2005 10:52
Til: Væhle, Olav
Emne: VS: Matre Havbruksstasjon

Hei

Dette er den siste elektroniske versjon av spunt og graveplan (som jeg har).
Etter denne har det vært to revisjoner,
Revisjon 2 - endringer på spuntavstivinger, endret høyde
Revisjon 3 - Graveplan for filter og utslippskum

Utført er i henhold til tegning, men bredden på kassen er økt med 30cm på sjøsiden.
Dette ble gjort etter avtale med RIB for å være sikker på å unngå problemer med monteringen av senkekassen.

Hilsen
Stein

Fra: Terje Skevik [mailto:terje.skevik@smias.no]
Sendt: 2. juli 2004 11:52
Til: Larsen Stein (NO)
Kopi: staale.liland@ncc.no
Emne: Matre Havbruksstasjon

Etter avtale med Hilmar Lilleøren sender jeg spunt og graveplan for pumpekum.

Vennlig hilsen
SMIDT &
INGEBRIGTSEN AS Rådgivende Ingeniører i bygg- og anleggsteknikk
Terje Skevik

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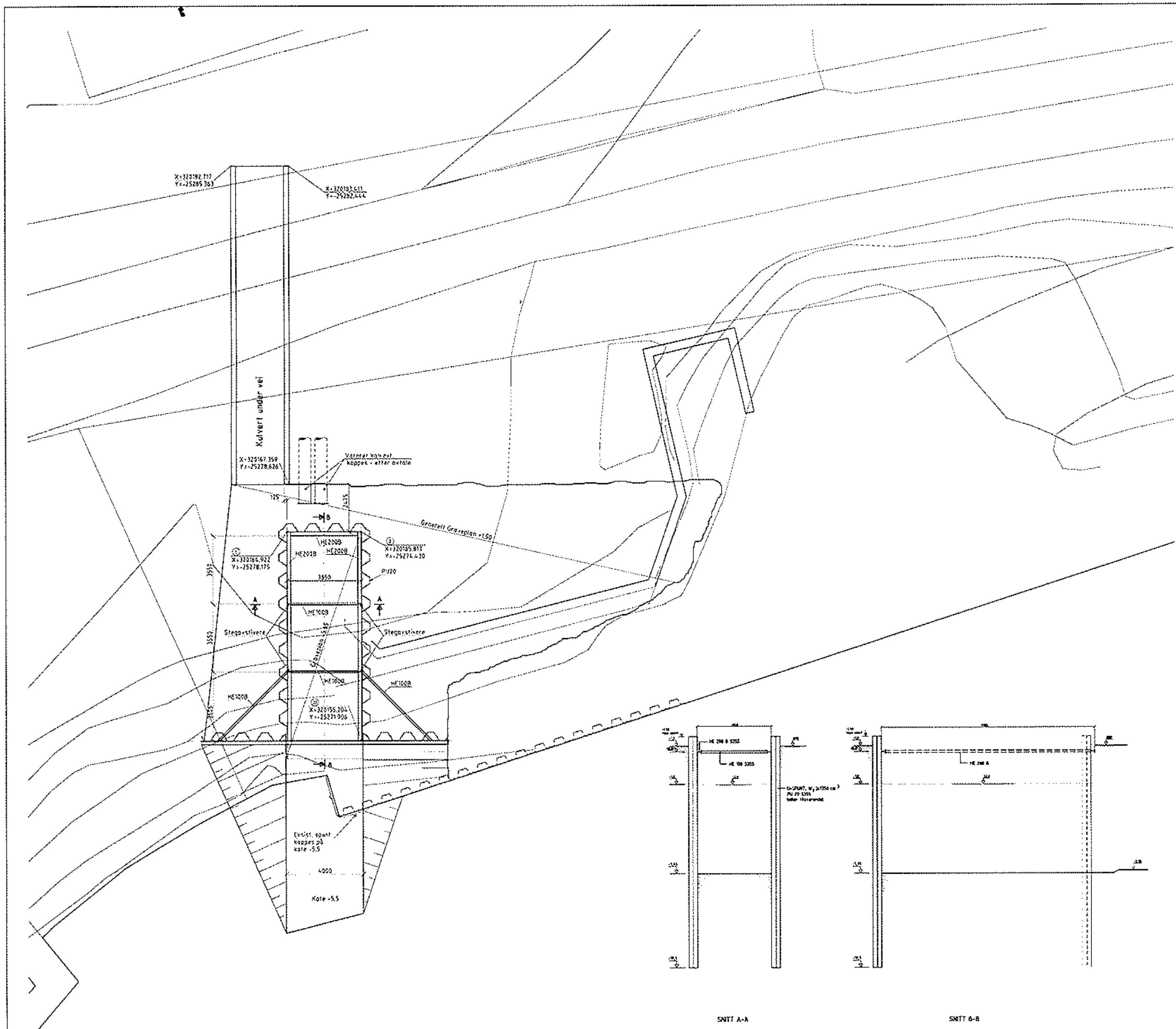

SPUNTKONSTRUKSJON PROSJEKTERT AV
MULTICONSULT avd. NOTEBY

96017 HAVFORSKNINGSINSTITUTTET, MATRE HAVBRUKSSTASJON

Revisjon	Dato	Tekst
1	18.06.03	ARBEIDSTEGNING

STATSBYGG

96017 HAVFORSKNINGSINSTITUTTET, MATRE HAVBRUKSSTASJON

ARBEIDSTEGNING

PUMPEKUM
Spunt- og graveplan

ALT. 2

12282		B	2	10	SP100	B3	1
18.06.04	1:100		T.S	H.L			18.06.04

MÅLESTOKK A3: 1:200

ARK: ☐

RIB: ☒ Smidt og Ingebrigtsen AS, Østre Nesttunveg 12, 5852 Bergen

RIE: ☐ KV Engineering AS, Lyngbøveien 28, 5163 Bergen

RIV: ☐ Vest-Consult A/S, Kokstadveien 27, Pb 38 Kokstad, 5863 Bergen

SMIDT & INGEBRIGTSEN AS

Væhle, Olav

Fra: Larsen Stein (NO) [Stein.Larsen@ncc.no]
Sendt: 31. januar 2005 10:40
Til: Væhle, Olav
Emne: SV: Spunt

Hei

Det ble benyttet spunttype "Larsen" SP 605.

Totalt levert 410m2

Jeg er litt usikker på hva du mener med geometri ?

Stein Larsen

Fra: Olav.Vaehle@statsbygg.no [mailto:Olav.Vaehle@statsbygg.no]
Sendt: 28. januar 2005 14:05
Til: Larsen Stein (NO)
Emne: Spunt

Hei Stein

Kan du gi meg opplysninger om hvilke spuntnåler som ble benyttet, og geometrien for det endelige resultatet?

Hilsen
Olav

Væhle, Olav

Fra: Væhle, Olav
Sendt: 20. desember 2004 15:40
Til: 'hilmar'
Kopi: 'odd.lothe@opticonsult.no'
Emne: VS: 96017 Matre havbruksstasjon, Beskrivelse av spuntnåler

Hei Hilmar

Jeg har fått vår geotekniker Rolf Jullum til å se på kravene til spuntnåler som beskrevet i K208. Han fikk ikke vite noe om saken vi diskuterer med NCC på forhånd. Jeg oppfatter dette som et objektivt svar.
Som du ser anbefaler han flere løsninger, hvorav kun en tilfredsstiller kravene på tegning. Rolf fikk kun teksten, og ikke tegning, da entreprenørene bruker for det meste kun postbeskrivelsen ved prising.
Det ser ut som det finne rom for mistolkninger, og at vi kanskje burde vurdere om NCC har et poeng. Informasjonen på tegningen derimot taler til vår fordel, men er etter hvordan jeg tolker Rolf Jullums kommentarer, i konflikt med beskrivelsen.
Gå gjennom dette og gi en redegjørelse på hvordan du mener vi bør gå videre.

Hilsen
Olav

-----Opprinnelig melding-----
Fra: Jullum, Rolf
Sendt: 20. desember 2004 14:33
Til: Væhle, Olav
Kopi: Shahrokhi, Farzin
Emne: 96017 Matre havbruksstasjon, Beskrivelse av spuntnåler

Svaret mitt ligger med rødt nedenfor.

rolf

Sjefingenior Rolf Jullum
Fagansvarlig geoteknikk i Statsbygg
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-----Opprinnelig melding-----
Fra: Væhle, Olav
Sendt: 17. desember 2004 12:02
Til: Jullum, Rolf
Emne: Beskrivelse av spuntnåler

Hei Rolf

Kan du gi meg din tolkning av hvilken spuntnål entreprenøren naturlig vil prise når han leser denne beskrivelsen.
Kan du også gi meg tilbakemelding på formuleringen av posten sett fra RIB.

Hilsen
Olav

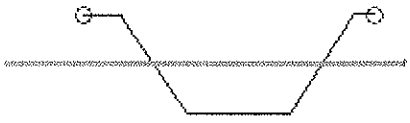
LEVERING AV SPUNTNÅLER AV STÅL

Type, kvalitet: Varmvalset stålspunt av kvalitet S356 GP

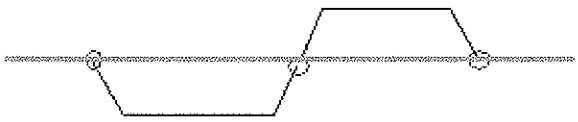
Alle spuntprofiler som benyttes er varmvalsede (jeg kan i alle fall i farten ikke komme på at vi har benyttet noe annet). Dette har med seighet, geometrisk noyaktighet å gjøre. Angitt kvalitetsbetegnelse er en stålkvalitet etter NS.

Dimensjon: Uspunt med nålebredde B=600mm og motstandsmoment Wy>1350 cm3

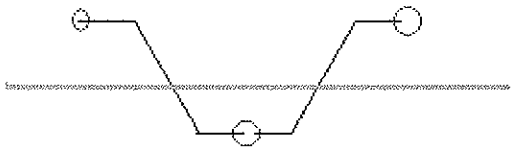
"Uspunt er ikke et fagord. Her legges inn en enkel beskrivelse av de ulike hovedspuntvariantene (det finnes flere ...):



Dette er et "u-profil" der låsene sitter ved de røde markeringene. Nøytralaksen vil her gå der streken gjennom profilet ligger.



Dette er et profil der skjøtene ligger i nøytralaksen, men det er fortsatt et u-profil.



Dette er et Z-profil der låsene ligger utenfor nøytralaksen.

[Jullum, Rolf]

Med nålebredde menes den horisontale avstanden langs nøytralaksen (alternativt spuntlinjen) mellom to låser.

Motstandsmoment (skal egentlig ha enhet cm3/m) er det viktigste kriterium for å angi styrken til profilet. Når rådgiver dimensjonerer spuntveggen og beregner jordtrykk og belstninger og derigjennom finner moment, vil han så beregne minimum nødvendig motstandsmoment. Dette fordi entreprenørene da kan gå i tabeller for å finne et profil som vil tilfredsstille styrkekravet. Rådgiver bestemmer altså ikke et spesifikt profil men angir en nedre grense for styrken som entreprenørens profil må tilfredstille.

Dokumentasjon: Verkssertifikat

Verkssertifikatet gir dokumentasjon på stålkvaliteter (flytespenninger, karboninnhold,...). Ut over dette skal det normalt angis toleransekrav, krav til rethet for spuntnålen, krav til tetting eller sveising av låsene.

For U-profil antas 20% reduksjon av oppgitt motstandsmoment på grunn av lås i nøytralaksen

Det er riktig at man reduserer motstandsmomentet ved profiler der låsen ligger i nøytralaksen. Dette betraktes som et standardkrav som alle benytter. det kan sies endel om dette, da det egentlig er litt løselig fundert, men praksis er slik. Hvis du har et behov kan jeg forklare mer.

Jeg vedlegger noen profiler som kunne være naturlige valg å ta for en entreprenør.

Alternativ 1 er Larssen 16W med Wx=1601 cm3/m (lås utenfor nøytralaksen).

Alternativ 2 er Arbed BZ17 med Wx=1670 cm3/m (lås utenfor nøytralakse).

Alternativ 3 er Larssen 23 med Wx=2000 cm3/m (lås i nøytralaksen).

Alternativ 4 er Larssen III med Wx=1350 cm3/m (med lås i nøytralaksen).

Alternativ 5 er Hoesch 134 med Wx=1700 cm3/m (med lås utenfor nøytralaksen).

Når beskrivelsen er så presis på motstandsmoment som 1350 og ikke bar > 1300 f.eks. tyder det på at han har tenkt på Larssen III, men dette stemmer ikke helt da bredden på denne er 400 og ikke 600 mm.. I beskrivelsen er det oppgitt Wy >1350 cm3, noe som er underlig i og med at det er motstandsmomentet om x - aksen som normalt benyttes og det normale er også at motstandsmomentet oppgis med en verdi pr. løpemeter spuntvegg (derfor /m i enheten).

De profilene jeg har valgt ut er valgt ut med hensyn til å liggge minst mulig over motstandsmomentet, dvs. at bredden ikke har vært utslagsgivende. Skal vi tilfredsstille breddekravet også vil ingen av profilene tilfredsstille kravene. Larssen 61 og 62 tilfredsstiller breddekravet med ikke motstandsmomentet. Skal du tilfredsstille breddekravet må du opp i sammensatte profiler som Larssen 420 (som er satt sammen av Larssen 42), men dette rimer ikke med U- profil kravet. Det ser ut til at det har vært noe kompetansebrist ved beskrivelsen, slik at det er satt et ubalansert krav, med ubalanse mellom breddekrav og krav til motstandsmoment.

Det klart viktigste kravet for spuntveggen er motstandsmomentet, slik at vi ved strid må holde oss til dette og akseptere avvik for bredden (som egentlig ikke er viktig).

[Jullum, Rolf] Med denne kvaliteten på beskrivelsen introduseres en usikkerhet, også for det øvrige materialet. FTG burde ta en gjennomgang av dette for å sjeke sikkerheten. Vi snakkes hvis du trenger mer.

Rolf J.