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Environmental Impact of Offshore Concrete Structures
Influence sur l'environnement des Structures Offshore en Béton
Umwelteinflüsse aus Bau und Betrieb von Offshore-Plattformen

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SUMMARY
This paper discusses experience from concrete platform construction in Norway. It deals with building site requirements vs. residential interests, fishing interests inshore, sea water contamination offshore and platform removal.

Influence de l'environnement sur les phases de construction et d'exploitation

Résumé
L'article présente les expériences norvégiennes de construction en mer en béton. Il traite des conditions posées aux sites par opposition aux intérêts privés, des questions de la pêche côtière, de la contamination des eaux de mer au large et de la démolition ultérieure des ouvrages en mer.

Umwelteinflüsse aus Bau und Betrieb von Offshore-Plattformen

Zusammenfassung
Dieser Artikel diskutiert Erfahrungen beim Bau von Betonplattformen in Norwegen. Er handelt von Bauplatzerfordernissen gegenüber Anwohnerinteressen, Küstenfischereiinteressen, Meerwasserverun-reinigungen auf See und dem Entfernen der Plattform.

INTRODUCTION

The design and construction of concrete offshore platforms for the North Sea have been continuous activities in Norway since 1971. There have been a number of technical improvements during this period, related to material strength, analysis methods, slipforming techniques, computer aided design etc; at the same time there have been a growing awareness of the environmental issues that are consequences of concrete platforms. This paper discusses experience from concrete platform construction in Norway concerning:

- building site requirements vs residential interests
- fishing interests inshore
- sea water contamination offshore
- platform removal

BUILDING SITE REQUIREMENTS

The dimensions of concrete platforms make them major undertakings. Data from three ongoing projects are listed below to illustrate the magnitude:

Project Operator	Sleipner Statoil	Draugen Shell	Troll Shell
Concrete volume, m^3	72.000	85.000	225.000
Height, m	112	290	370
Bare area, m^2	11.700	9.300	14.000
Construction period, months	34	35	44
Reinforcement, tons	17.000	22.000	67.000
Installation date	1992	1993	1995

The construction site at Hinna is located right within a residential area and we have therefore had to deal with a number of conflicting issues, some of which are satisfactorily resolved and others that remain to be solved;

- **View.** The site occupies an area of about 30 hectare and there is no way you can hide that. Two drydocks, a multitude of cranes and barges, stores, workshops, cement silos, offices and prefab areas make for a different view than trees and wetland. Personally, I am not so concerned about the view, that can be restored, but the loss of wetland represents an irreversible act.

- **Noise.** The Norwegian State Pollution Board has laid down specific requirements. Initially our attitude was to modify our activities solely to make sure that the requirements were met. Lately we have developed a more active approach where we define our own goals and where we see noise as an element in the much broader concept of work environment, i.e. the interaction between job planning, safety, construction methods, weather protection and working hours. Thus, noise virtually ceases to be an issue if we properly identify the work environment to be the mitigating factor. Status to day is that we have some way to go, although the noise level as such is formally resolved.

* We meet the SFT requirements w.r.t. noise. There are occasional exceptions, but not regular or planned deviations. During daytime (06-18 hrs) the maximum noise level at the nearest residential house should not exceed 55 dB (A), during the evening (18-22 hrs) 50 dB (A), and at night and Sundays 45 dB (A).

  A 4,5 m barrier has been constructed along the site perimeter where there are residential houses.

* Light represents a problem. There are prolonged periods where there is a two shift system and regular periods with around the clock operations. Particularly during the winter months this is a disturbance for the neighbours.

* Traffic is another problem. Roads both inside and outside the site have been upgraded to reduce noise and dust sources, but there will be traffic associated with a busy site. There is also marine traffic, both to unload bulk materials and equipment and to service the inshore construction site in the middle of the fjord. All marine traffic is coordinated with the local harbour boards of Stavanger and Sandnes.

* The main constituents of concrete, cement, water, aggregates, are locally obtained and do not represent major quantities in terms total national supplies. One aspect worth noticing here though is that civil engineers in Norway have hurt a number of salmon rivers by removing river bed aggregates. This is a tragedy considering that our forefathers have harvested salmon for thousands of years from these rivers. This practice is now illegal, but still persists in some areas.

* Building site effluents are tightly controlled and are not considered to be a problem. However, particular attention has to be paid to operations like injection of prestressing cables, epoxy applications and machinery maintenance.

FISHING INTERESTS INSHORE

The inshore constructions sites occupies substantial areas of the fjord when the mooring systems are included. Typically, there are 4 to 5 anchors legs, each having a length of 1.000 m - 1.500 m. This effectively closes the area to commercial fishing. This is alleviated by monetary compensation to the local fishermen's council. The magnitude of this is agreed according to the area covered by the inshore sites and the length of stay. This has been resolved without major conflicts.

SEA WATER CONTAMINATION OFFSHORE

Offshore drilling and production platforms are subject to a host of regulations to minimise the environmental impact. Designers of concrete platforms provide one feature that is not common for other materials - that is the possibility of crude oil storage. To date about 10 North Sea platforms have inbuilt storage facilities. All of these utilize sea water as ballast medium with an interface that continuously moves as oil is produced and/or exported. Measurements show that the ballast water discharge contains 6 - 10 ppm of oil which is well below 25 ppm that is the maximum permitted. However, it must be borne in mind that,

- technically, there is no practical way of reducing the contamination
- 10 ppm represents an annual level of about 100 tons oil spill for a big North Sea platform. In perspective, the same platform will probably have other sources of contamination and leakage that exceeds the ballast water oil, but nevertheless, this is an additional load

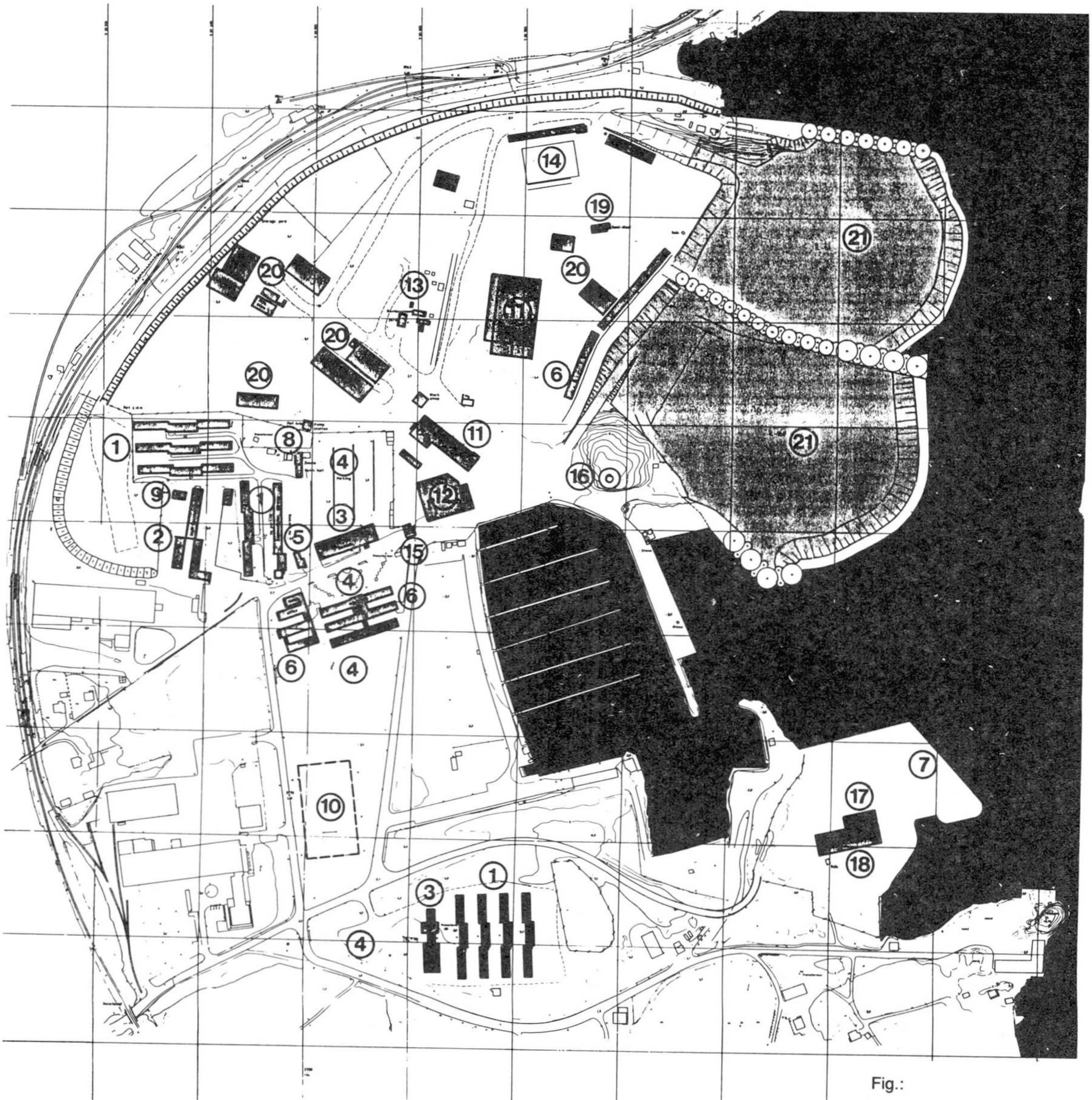
For the oil company which operates the platform the issue is to decide whether oil storage is needed or not. If it is, then it is the responsibility of the designer to engineer a storage system with minimum contamination. The two main areas to be addressed are the wet vs. dry system and the piping and instrumentation principles. All systems have so far been wet, but the first dry system, i.e. no ballast water, will be operational offshore Holland in 1992.

PLATFORM REMOVAL

Platform removal is a matter of disconnecting all risers and pipelines, plugging the wells and then reversing the installation procedure. This is, of course, a very simplistic, representation. But as a platform has reached the end of its operational life, the biggest challenge will be disposal, not removal. The topside can certainly be dismantled, lifted ashore and recycled like other industrial scrap, but the concrete structures will have to be dumped, possibly in a deep fjord or the Atlantic trench.

HINNAVÅGEN

1. LABOUR ACCOMODATION
2. STAFF ACCOMODATION
3. CANTINE
4. PARKING AREA
5. RECEPTION
6. OFFICE BUILDING
7. QUAY
8. SAUNA/GYMNASIUM
9. SQUASH COURT
10. FOOTBALL PITCH
11. MECHANICAL WORKSHOP
12. STORE
13. REINFORCEMENT PREFAB. AREA
14. FORMWORK PREFAB. AREA
15. SECURITY
16. NC's LEANING TOWER
17. CHAIN INSPECTION
18. MARITIME STORAGE
19. SAND BLASTING
20. TEMP. STORAGE AND WORKSHOPS
21. DRY DOCK



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