A Study on the Development of Semi-Submersible Drilling Rig with Oil Recovery System

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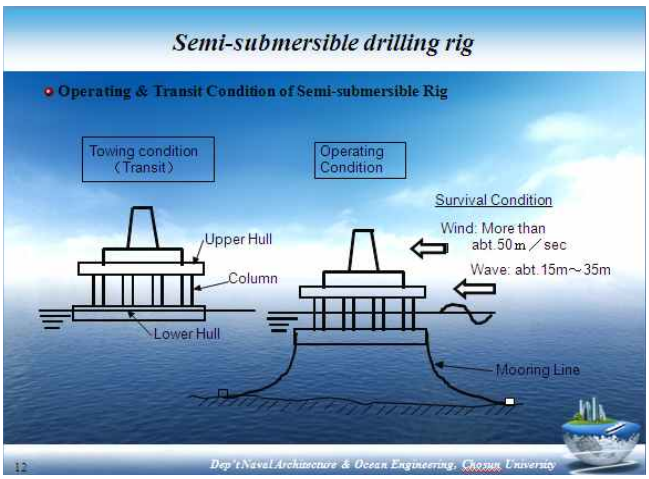
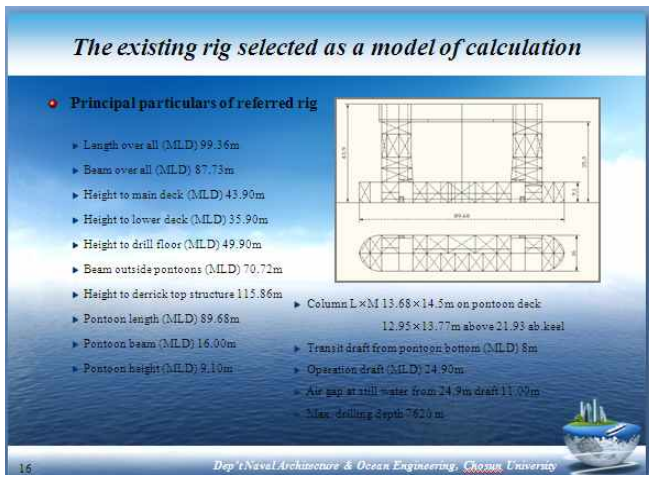
요 약 : 반잠수식 시추선의 주선체(lower hull)를 세 가지 타입으로 설계하여 주선체에 대한 유체정역학적 계산, 조종성능 및 내항성능 계산 그리고 이론계산을 수행하여 wave distribution과 height도 각각 비교 분석하였다. 주선체의 Convention type, Bulbous bow type, 그리고 Ice breaking type 중 Ice breaking type 선형의 성능이 가장 우수하였다.
다음으로는 반잠수식 시추선의 모든 조건(작업, 이동, 생존)에서 주기둥(column) 또는 주선체(Lower)가 손상되어 부력을 상실했을 시 전복 되지 않도록 고안된 예비부력 기능과 기름 유출 사고시 기름을 회수 할 수 있는 기능을 갖춘 유회수 겸용 예비부력 탱크를 개발하였다.

핵심용어 : 반잠수식 시추선, 선형개발, 내항성능, 예비부력 탱크, 유회수 장치





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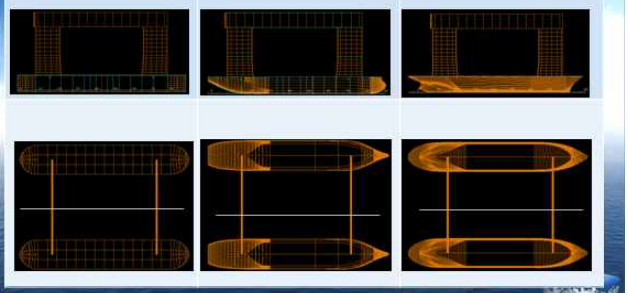
Type of General arrangement

Conventional Type(A)	Bulbous Bow Type(B)	Ice Breaking Type(C)



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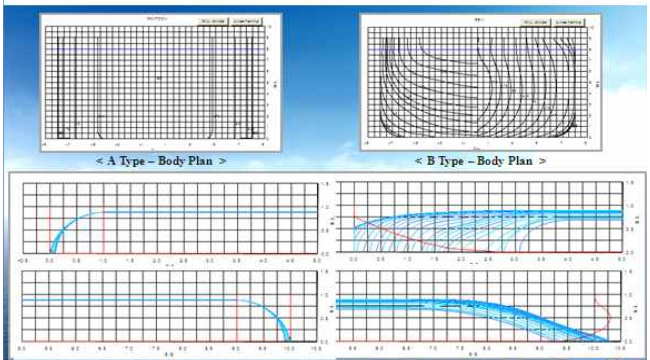
Lines



< A Type – Body Plan >

< B Type – Body Plan >

< A Type – Profile and Half - Breadth Plan>

< A Type – Profile and Half - Breadth Plan>

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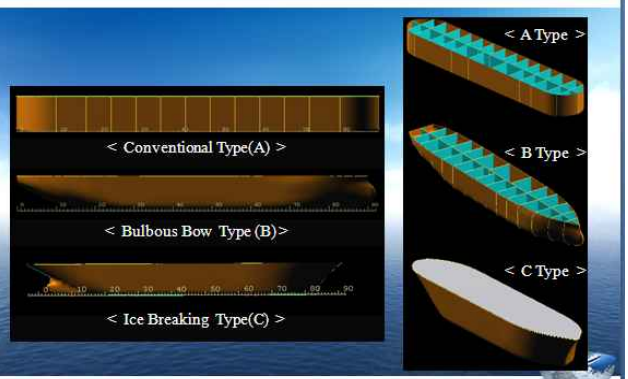
Type of Hull Form



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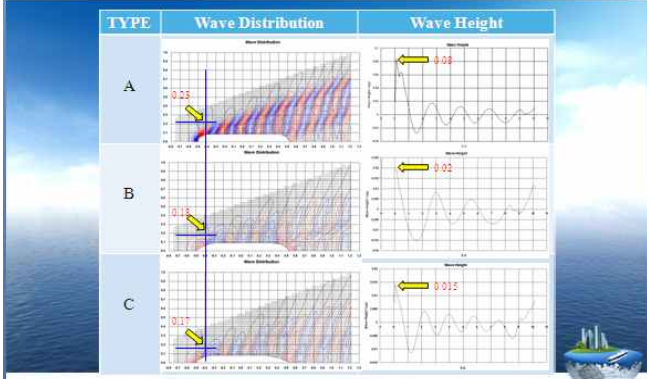
Wave & Flow Simulation



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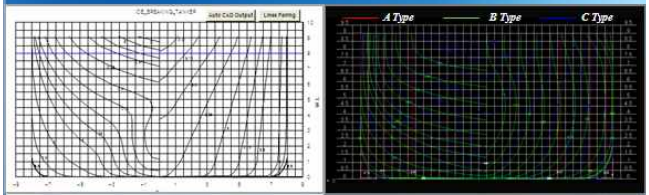
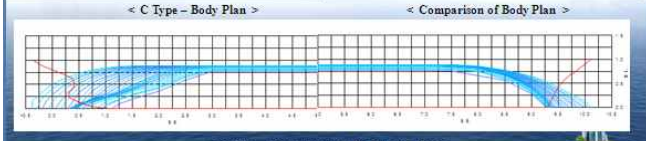
Lines



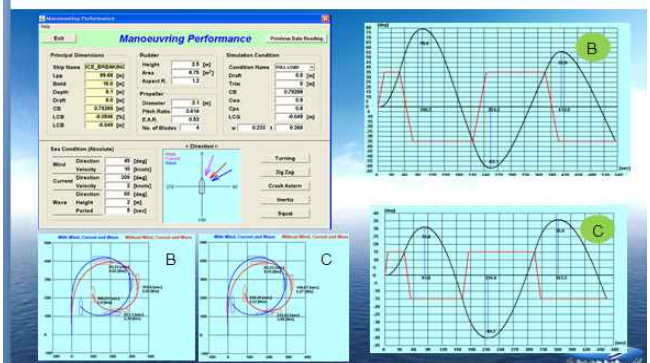
< C Type – Body Plan >

< Comparison of Body Plan >



< C Type – Profile and Half - Breadth Plan>

Maneuvering Performance (Turing & Zig Zag)



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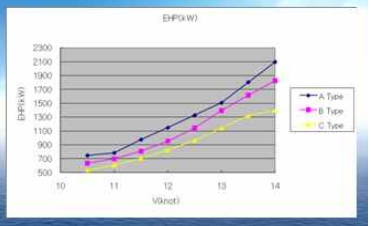
Effective Horse Power(EHP)

EHP(kW)			
Vs [knot]	A Type	B Type	C Type
10.5	748	633	533
11.0	785	698	806
11.5	976	806	706
12.0	1148	953	823
12.5	1326	1143	964
13.0	1506	1395	1140
13.5	1802	1615	1321
14.0	2095	1825	1599

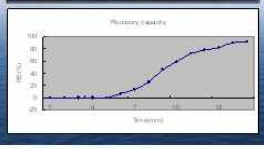


Sea trial and performance test

High oil recovery efficiency

- High oil recovery efficiency by many circulation steps of oil-water separation
- Expect more efficiency in actual ship than model ship





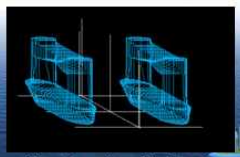

Extra Buoyancy

Profile view	Transverse view	3D view

Hydrostatic calculation

Shipmaster and FORAN system program for conducting hydrostatic calculation and stability calculation was used and applied.

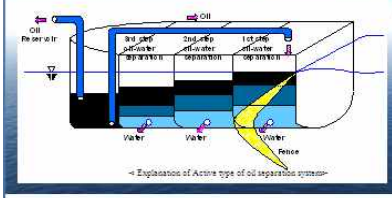
- The calculation process
  - *The hull form about the various structures consisting of a semi-rig(pontoon, lower column, upper column, deck structure, bracing) was defined.*
  - *From this process, producing the calculation sections of dense distance made up of polygons, the areas and moments about each calculated section are calculated. By adding the calculation result for the longitudinal direction, the data of hull form for a semi-rig can be gained.*
- The calculation result
  - *The calculation result carried on the project rig is shown in Table*
  - *In this chart, hydrostatic calculation result from the draft 1.0m to 27.0m were calculated at 0.5m intervals*



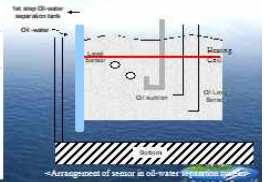
Computing sections of the design rig

Development of active type oil-water separation system

- *The oil which passes through the inlet undergoes active separation in 3 stages and this process is repeated continuously thereby resulting in high filtration effect.*
- *The sea water is thrown out of the vessel automatically through outlet holes located at the bottom of the vessel in between hulls.*
- *So the momentum of inflow and outflow is large as a result of which this Oil-Recovery vessel can recover oil at a very high rate compared to the other recovery vessels in operation now a days.*
- *In last tank of active type oil separation system two water level sensors and one oil level sensor are operating for the collection of denser than 90% oil as shown in Fig.*



<Explanation of Active type of oil separation system>



<Arrangement of sensor in oil-water separation tank>

Conclusion

1. *Ice breaking hull formed semi-submersible rig developed of which resistance and propulsion efficiency improved 15% by applying GA*
2. *Green rig with multi-purpose oil recovery system has been developed and its efficiency proved*
3. *Maneuvering and seakeeping performance are satisfied compare with existing rig*
4. *Intact and damage stability are satisfied with DNV requirement*