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(72) Inventor; and
(71) Applicant : NG KHIM KIONG [SG/SG]; 94 Man Chempaka Kuning, Singapore 489129 (SG).

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(54) Title: BUDDY CANTILEVER SYSTEM FOR JACK UP RIGS FOR USE WITH SELF ELEVATING DRILLING RIGS (OIL & GAS INDUSTRY)

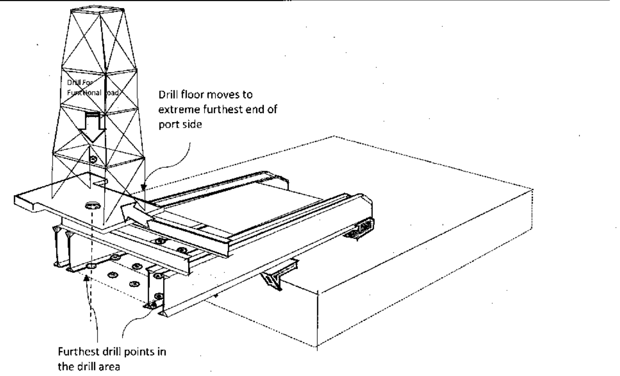

Figure 4b - Buddy Cantilever System
("Buddy" installed to act as double-beam to the port and starboard sides of conventional cantilever)

(57) Abstract: This invention is centered on assisting, enhancing and improving the conventional cantilever design such that it can result in higher load carrying capacity. Such an adaptation utilizes the invention that has superior, novel and innovative features. By using this invention, it immediately improves load carrying capacity of cantilever in the drill area and thus the derrick hook load can be maximized at extreme corners of the drill area circumscribed by the combination of movement of drill floor and cantilever. The invention is based on an add-on concept applicable to existing cantilevers or new installations. It is portable in design and can be shared among a fleet of drilling rigs of similar cantilever design The invention is made up of simple structural components that can be adapted to existing rigs or built in new rigs. The "buddy" beam can be made in sections for ease of handling and installation. The invention does not involve complicated moving systems, hydraulic or electrical. Needless to mention, the maintenance aspect is also simple and easily manageable. Overall cost to include the invention in existing or new rigs to achieve the higher load requirements is highly justifiable .

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BUDDY CANTILEVER SYSTEM FOR JACK UP RIGS

FOR USE WITH SELF ELEVATING DRILLING RIGS

(OIL & GAS INDUSTRY)

DESCRIPTION

Field of the Invention

This invention relates to the design of an apparatus and a method called Buddy Cantilever System for increasing the carrying capacity at extended positions of the cantilever of a self elevating drilling rig (Unit), or otherwise termed as jack-up rig, and therefore maximizing the hook load to its rated capacity or thereabout in the drill area.

Fundamentally, it is a different and innovative design and method enabling the stress in the cantilever beam to be within its structural strength limit in bending or buckling when fully extended out with increased load. Not only is the design unique and innovative, the system as a whole is made very simple and pragmatic, a concept never used before and it provides equivalent or better loading results than the relatively newer invention systems such as the "X-Y Cantilever" or "Rotating cantilever" (see ***Figure 2b and 2a)*** and does away certain disadvantages of these newer inventions in system complexity and deck space utilization, not to mention reducing capital expenditure. Working deck space is always a valuable concern of self-elevating drilling rigs.

This invention, apart from performing its intended function for the Unit, is shareable among Units. Because its application is essentially different and more pragmatic and is used only when the operating conditions require it. It is an enhancement rather than a replacement of the conventional cantilever system design either in existing rigs or new build rigs. In addition, the manner it is used in application, the term "Buddy" is appropriately used to describe the partnering, assistance or help it provides in enabling the existing cantilever to work stronger.

A typical load or carrying capacity of conventional cantilever is depicted in ***figure lb.*** The drill floor carrying capacity diminishes as the drill centre extends out and away from the rig transom and moves to the extreme port or starboard side of the cantilever. Such is the design limit phenomena of an extending or hanging cantilever when the load is applied at the hanging end and to the extreme corner from the centre line. For the same hanging distance, this unique and innovative invention makes the conventional cantilever stronger in all aspects.

The following terminologies (in alphabetical order) commonly used in relation to a cantilevered self elevating or jack-up rig are defined below to assist in understanding the novel application of the Buddy Cantilever System **("BCS").**

Terminology	**Description**
Air gap	Air gap is the distance between sea level and the bottom of rig hull. When using cantilever on work-over activities, the air gap is adjusted such that the cantilever can reach over and drill down a platform. Any increase in air gap generally reduces the operating performance of a rig (see ***figure 9.0***)
Cantilever	The cantilever is used in self-elevating drilling rig to drill at a distance away from its transom either in exploration or over a well head or production platform. It normally carries a drill floor at its far end over which drilling equipment, drill pipes etc are used for drilling including performing all sorts

	of down-hole services (see ***Figure 2c and figure 9.0)***
Cantilever beam	A structural member to withstand bending or buckling caused by the drill floor sitting at the cantilever's aft end. Typically, there are two beams to make cantilever (see ***figure la)***
Cantilever Load Chart	A chart to indicate the safe working load the cantilever can carry when the drill floor moves within the drill area (see ***figure lb).*** The load tonnages shown are estimates and indicative of typical cantilever load chart trends. Load charts shown in figures 6.0 and 7.0 reflect how BCS can effect positive changes and load carrying improvements.
Drill Floor movement and Drill Area	The Drill Floor (complete with floor structure, derrick and drilling equipment etc.) is located at the aft end of both conventional and non-conventional cantilevers. In conventional cantilever, the drill floor is designed to move transversely while the cantilever longitudinally. This enables a drill area limit (see ***figure 3.0)*** to be created as described by the combination of cantilever and drill floor movements. In non-conventional cantilever, the drill floor structure is fixed and integral with the cantilever. To create a drill area, the whole cantilever is designed to move both longitudinally and transversely for the X-Y system. The Rotating system utilizes an arc movement for the cantilever to create the drill area. (see ***figure 2a)***
Drill Floor strong back	The structural beam to support the drill floor is sometimes called the "strong-back". Two such

	strong-backs are commonly used to support the drill floor weight and load (see ***figure lb)***
Hold Down structure	As the cantilever moves aft-ward and its centre of gravity passes the transom, it will hang and tip over the aft. Hold Down structure is to hold it against tipping over (see ***figure 6.0).***
Load Curve	The load capacities, at different positions of the cantilever and drill floor, plotted against the travel of cantilever or drill floor provide two separate sets of load curves (see ***figures 5a, 5b and 8.0)***
Non-Conventional cantilever	New inventions to carry and move the drill floor for drilling away from rig stern or transom. Two inventions are mentioned. One is the X-Y Cantilever and the other is the Rotating cantilever (see ***figure 2b and 2a).*** *Disclaimer : any descriptions made with regard to these two inventions are purely the writer's own interpretation to the best of his knowledge and may not be absolutely true or correct.*
Overturning stability	When the Unit is elevated, the final CG of the rig affects the overturning stability. The cantilever carries a sizable variable load of the rig, therefore the position of the cantilever during storm condition can affect the rig stability.
Pedestal	Pedestal is meant to be additional support structure to distribute the weight with applied load of the cantilever when it sits on the main deck of the Unit.
Push Up structure	A structure to specifically provide the weight/load

	reaction at stern to hold up the cantilever. It works in conjunction with Hold Down structure.
Transom	The stern vertical surface of the Unit over which the cantilever hangs (see ***figure** 9.0)*
Variable deck load (VDL)	A rig is designed and has a limit VDL so as not to exceed the stress limits of the structure particularly the legs during worst weather conditions and also stability when fully elevated in the ocean.

Background of the Invention

To appreciate the novelty of the invention, it is important to know the conventional cantilever installed and used on the Unit moves longitudinally aft-ward away from the rig transom when it is required to perform drilling operation at a distance. Its purpose is to bring the drill floor with the drilling derrick and drilling equipment to a point to begin drilling down into the seabed. The distance and the load it can carry when it overhangs at the aft end of the rig is important when the rig is working over a production platform (commonly known as work-over activities). This is one primary reason why cantilever is fitted on a drilling rig.

The drill floor sits above and at the end of the cantilever and is designed to be able to move transversely so drilling at various points is possible within the space envelope described by the combination of movements of the cantilever and the drill floor (see ***Figure 3.0).*** This is known as the drill area.

Such apparatus described above and other variations of such design achieve their objective in increasing the capacity of the cantilever thereby the drilling load or hook load can be maximized at all positions of the drill area. It is used when the overall load expectation in the corners of drill area prevents the conventional cantilever to perform safely. In other words, the apparatus is not required to be applied most times. This means it can be "not a permanent fixture" on the Unit if it is so desired to be. This uniquely presents itself as portable and share-able asset with other Units.

The background of the Invention is to provide an alternative and novel design to enable the conventional cantilever to perform better, stronger and achieve higher capacity drill area in a simple manner while having several advantages. The manner this novel system works is to utilize the "buddy" cantilever in conjunction with existing conventional cantilever system (see ***Figure 4a and 4b).*** Essentially, the "buddy" cantilever acts as the second beam in support of the drill floor as the drill floor load is shifted to either to the port side or the starboard side. ***Figure 4a*** shows one single "buddy" beam is installed should the starboard drill load expectation is to be higher. ***Figure 4b*** shows both sides are installed with "buddy" beams to support higher drill load expectations throughout the drill area. Alternatively, "buddy" beam can be shifted from one side to the other depending on extreme drill point load expectations. Such is the flexibility and cost effectiveness of this novel design.

First significant difference and substantial advantage of the present invention is that the application of the invention need not be a fixed asset of the rig and can be installed when the need arises. Yet it can do the job better than conventional cantilever in a higher load requirement environment that the conventional cantilever cannot. In comparison with non-conventional cantilevers like "rotational" or "X-Y" systems, it can even outperform them with higher load carrying capability (see ***figure 5a and 5b).*** Regarding these non-conventional systems (see ***figure 2a and 2b),*** immediately, one can see that it involves taking up much deck space which is highly valuable in a drilling situation.. They both involve making the whole cantilever rotate on the deck or move X-Y direction therefore occupying much deck space for such movements.

Second significant difference and substantial advantage of the present invention is that the simplicity in design and operation of the Buddy Cantilever System ("BCS") can allow the novel system to be implemented on existing cantilevers to achieve better performance capabilities without having the whole cantilever replaced by Rotating or X-Y system for the same reason of performance betterment. BCS is significantly an enhancement novel design concept. BCS maximizes and even increases load capacity of the cantilever to above what is currently known and achieved in the industry of self elevating Rigs (see ***figure 5a, 5b and 8.0).*** It presents itself as a possible enhancement to all existing conventional cantilever designs.

Third significant difference and substantial advantage of the present invention is that when BCS is employed, it is only when the drill load demand for a particular drilling operation requires that the cantilever, as a whole, must carry more load. That means that when different drilling rigs of similar rig design perform at different locations, conditions and different times, the occasion that requires BCS to be used by any one of the rig fleet makes the novel BCS a sharing asset or sharing structural equipment. In order that BCS is installed and made operational, certain adaptation is to be made on the rig. The adaptation to install BCS is relatively simple and cost effective. Comparatively, such adaptation to allow BCS to enhance a cantilever capability is minimal and negligible vis-a-vis a complete replacement installation to a X-Y or Rotational cantilever system - or for that matter a stronger conventional cantilever - not to mention the high cost impact (see ***Figure 6.0).*** Such a replacement is extremely expensive and difficult to effect without bringing the rig back to a shipyard for major refurbishment, and may not even be feasible due to existing deck space and congestion limitations. In conclusion, the distinct advantage in BCS is the sharing ability among similar design rigs and at low cost of expenditure to effect similar or better performance results.

Fourth significant difference and substantial advantage of the present invention is that BCS is purely a structural "add-on" and inherently does not require complicated mechanism to make it move or work. No need for high pressure hydraulic moving system or rack-pinion travelling mechanism. It can be made up in one structural piece or broken up to several pieces for joining at location all of which to allow easy handling and mobilization. Offshore support vessel or other transport means can easily bring BCS component to the rig at location for a particular usage. Such flexibility and portability cannot be found in current conventional or non-conventional cantilever systems (see ***figure 6.0).*** It can be tied to existing cantilever so that it moves as one integrated structural component. Alternatively, it can have its own portable winching machine, make use of rig crane as winching device and wire rope rigged to bring the BCS beam to any extended position to enhance the cantilever operating capabilities on the spot (see ***figure 6.0 and 7.0).*** All such adaptations of rigging and appurtenances to install and enable BCS to function as intended form part of the system invention.

Fifth significant difference and substantial advantage of the present invention is that BCS is able to allow an existing cantilever designed for only limited outreach (the limit amount of longitudinal travel aft-ward away from rig transom) to be altered to perform stronger at better outreach. This involves making extension to existing cantilever beams and together with BCS, the rig can be brought to a higher cantilever category performing level.

Needless to say a BCS design and invention optimizes apparatus utilization. As a result, cost savings in major cantilever refurbishment or correction costs, capital machinery expenditure and others to bring the cantilever to a higher performance level is obvious

The differences between BCS and non-conventional cantilever systems can be clearly observed by referring to tabulated points or comments under 'Results and Discussions'. Conventional system disadvantages and how BCS can assist to improve is also commented. BCS itself is an enhancement component of the conventional system and it is not meant to operate on its own except to support and enhance existing or new conventional cantilever system. This is BCS's novel, unique and inventive contribution.

The Objective of the Invention

The objective of the invention is to provide an improved, alternative and innovative design to enhance and improve existing or new conventional cantilevers such that the cantilever can meet the harsher demands of drilling in the industry. It also reduces the cost of fixed installation of a strong cantilever system on a Unit.

The Buddy Cantilever System ("BCS") design will obviate or mitigate the aforementioned situation of high costs, construction/installation/operation complexity and lack of usage optimization in the case of a Unit with non-conventional cantilever system. BCS at least provides the public with a useful alternative and cost effective choice with several advantages and can be adapted to existing conventional cantilever systems quite easily.

Statement of the Invention.

The BCS works to enhance the load bearing or carrying capacity of conventional cantilever design by being a "Buddy" as a second supporting beam (see ***figure 4a and 4b).***

The application of BCS allows the conventional to perform better thus matching and even surpassing some advantages that the non-conventional cantilevers like the rotating or the X-Y cantilever are claiming. Because it acts as an "add-on" to conventional cantilever system, it is applicable for use with existing conventional cantilevers on rigs built in the past and those in the future.

It is not intended for BCS to specifically compete, in design, with non-conventional inventions of "Rotating" or "X-Y" cantilever systems, but to present itself as a practical solution to meet a particular drilling demand or situation the current rig fleet and those in the future may have to deal with. Functionally, it is competitive and helps provides a wider choice of system to the public.

One should note that the application of BCS when used on jack up rig can be in the manner as a retrofit or refurbishment to existing rigs, or as part of new rigs currently being built and those in future. This is an enhancement concept that is new, novel and unique and the appurtenances and outfits to realize the function and completion of BCS all fall within this invention.

Whether as a retrofit or new installation, the ultimate objective is to achieve a stronger and better performing cantilever system. In simple technical term, BCS provides a duplicate or secondary beam of support when the drill floor load shifts to one side of the cantilever structure. BCS simply acts to provide the two beam support as if the load is still equally (or near enough) shared by the two beams of the cantilever before being enhanced by BCS.

Each BCS set to be incorporated into the Unit is basically made of the following components :-

- A main "buddy" beam (or two or more buddy beams) structurally similar to a new or existing conventional cantilever. It is not an additional support to any overhanging beam of the conventional cantilever but a secondary structure to increase the sectional modulus of the cantilever structure ***(see figure 4a and 4b*** and ***figure 8.0)***
- A "Push Up" structure to support the "buddy" beam (see ***figure 6.0)***
- A "Hold Down" structure to support or hold down the "buddy" beam (see ***figure 6.0)***
- Other pedestals as required for stowing the "buddy" beam when fully retracted and stowed. ***(see figure 7.0)***
- Tie-in outfits to utilize the cantilever skidding system to move or a set of rigging equipment to enable the same effect (see ***figure 7.0)***
- To have full effect of BCS, the "Buddy" beam must effectively be connected to existing beam such that structurally they become one. This will require detail

engineering of the attachment fixtures such the Buddy beam is sharing the load with existing beam, all of which fall within this invention.

Results and Discussions

The following table highlights and compares the BCS advantages over conventional system and also other systems such as Rotating or X-Y design. The table is in no way meant to be an exhaustive exploration of all of the features of the invention, and many of those not discussed will become readily apparent to a skilled reader once the full scope of the invention is understood.

No.	Features	Invention	Conventional	Rotting or X-Y cantilever
1.	BCS is an "add-on" to enable cantilever to perform high load capacity at all drill positions especially at extreme corners of the drill area	With its application, the cantilever beam is immediately enhanced in structural strength to support more load, matching or even surpassing that of unconventional cantilever when drill floor moves to extreme port or starboard (see ***figure 8.0***)	As it is, the load carrying capacity always diminishes when the drill floor travels to extreme port or starboard.	Cantilever provides a constant load carrying capacity across the transverse travel because the whole cantilever can move transversely or by rotating (see ***figure 2a and 2b***).
2.	Designed for use to enhance the Cantilever operating capabilities when required and not necessary a permanent fixture	BCS can be applied when there is a requirement for its usage in any drilling program so long BCS components are incorporated in the Unit for adapting its usage.	If the condition of a drill position requires a higher load carrying capacity than its rated capacity, the Unit will have to be repositioned such that the drill floor is is in the middle of the cantilever span.	The skidding system used in conjunction with such unconventional system is much more expensive and in many drilling conditions that don't require high load capacity at extreme port or starboard positions, the system is not fully utilized with such high capital outlay.
3.	Portability	Because it is removable from a Unit when not required and usable on other Units requiring it, its portability brings the total cost of a Unit down	A unit with conventional system, unless is enhanced with BCS, is limited and its usage not as competitive.	Unit with such system is competitive but the higher capital outlay cannot be shared among a few Units of the same design.

		when shared with other Units. This brings out its competitiveness in usage of the Unit.		
4.	Deck space" take-up" is negligible	BCS incorporation takes up a relatively small amount of deck space yet it provides a solution to higher load carrying demand of the cantilever (see ***figure 4a and 4b)***	The deck space saved does not improve its application at higher load demand in extreme drill positions.	The constant load curve is achieved at the expense of deck space. One has to always allow the deck space to be kept clear when the drill position shifts. This results in much deck handing of any temporary stowage of items in the way (see ***figure 2a and 2b)***
5.	Incorporation into existing operating Units to bring up Units' performance ability	BCS can be incorporated into existing rigs with conventional cantilever so that the Units can perform at higher load demands at all drill positions of the cantilever (see ***figure 4a and 4b)***	Replacing a conventional cantilever with another stronger conventional cantilever does not make much sense if BCS is there to be a better solution.	To replace a conventional system with a non-conventional system requires much alteration and systems corrections (hydraulic, all services via drag-chains etc.) and deck space availability may not even allow it, not to mention the high capital expenditure
6	Maintaining air gap	BCS does not require the Unit to raise higher to reach over platform in work-over activities and it allows the Unit to keep the air gap as originally designed for (see ***figure 9.0)***	If an auxiliary frame is used to extend the push up structure so that the hang-off of cantilever is extended further aft-ward to improve load capacity, it can become an obstruction when kept close to a platform (see ***figure 9.0)***	No difference in air gap issue

Modifications of the Preferred Embodiments

While the invention has been described with particular reference to certain embodiments thereof, it will be understood that various modifications can be made to the above-mentioned embodiment without departing from the spirit and scope of the present invention. The examples and the particular proportions set forth are intended to be illustrative only.

The skilled reader will instantly realize that, although the examples have been described for the 'Buddy Cantilever System' in support of conventional cantilever system of a self elevating Unit, these aforementioned descriptions are merely illustrative and will vary depending on the application and the requirements of the Unit. An example of such variation of BCS to the Unit's cantilever is done with the Buddy beam located on the inside (inboard) and supporting the cantilever at some point before the end and not as a full duplicate of a whole beam ***(figure 10.0).***

Information Disclosure References

Information relating to inventions that may have been previously filed in by others and that is of similar invention can only be determined after a search by the authority

THE INVENTOR'S CLAIMS

(1) A self elevating drilling rig **(Unit)** suitable for off-shore oil and gas drilling and other operations comprising a cantilever system where a drill floor is located above for drilling over a drill area; and at extreme port or starboard zones of the drill area, the load carrying ability of the cantilever diminishes due to cantilever structural strength limitations; characterized in that the cantilever is now assisted and enhanced by the Invention called 'Buddy Cantilever System" (BCS) that is novel in design and performs to reduce stress induced from bending moment or buckling in the original cantilever beam by sharing the stress with the "Buddy" beam, and

(2) A self elevating drilling rig **(Unit)** suitable for off-shore oil and gas drilling and other operations comprising a cantilever system where a drill floor is located above for drilling over a drill area; and at extreme port or starboard zones of the drill area, the load carrying ability of the cantilever diminishes due to cantilever structural strength limitations; further characterized in that the Invention works on a different, novel and unique principle of duplicating original cantilever beam thus providing a combined larger section modulus resulting in reducing stress in the cantilever beams, and

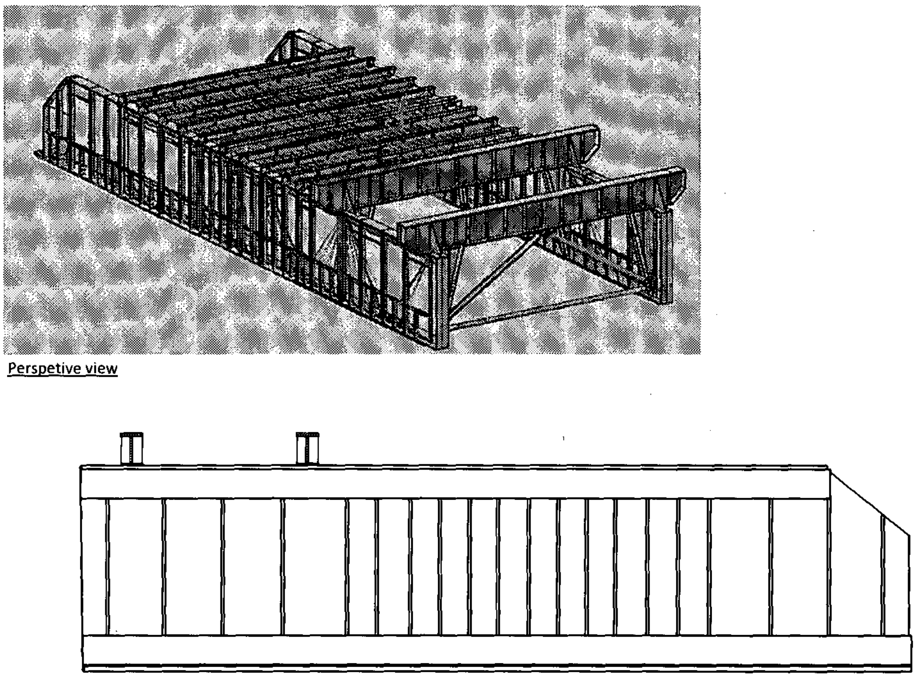
(3) A self elevating drilling rig **(Unit)** suitable for off-shore oil and gas drilling and other operations comprising a cantilever system where a drill floor is located above for drilling over a drill area; and at extreme port or starboard zones of the drill area, the load carrying ability of the cantilever diminishes due to cantilever structural strength limitations; further characterized in that the Invention allows the load carrying capacity at extreme port or starboard zones of the drill area to increase, meaning a higher drill depth can be achieved, and

(4) A self elevating drilling rig **(Unit)** suitable for off-shore oil and gas drilling and other operations comprising a cantilever system where a drill floor is located above for drilling over a drill area; further characterized in that the application of BCS is feasible for existing or new conventional cantilever systems, , and

(5) A self elevating drilling rig **(Unit)** suitable for off-shore oil and gas drilling and other operations comprising a cantilever system where a drill floor is located above for drilling over a drill area; further characterized in that the Invention can be shared among a fleet of drilling rigs of similar cantilever designs, and.

(6) A self elevating drilling rig **(Unit)** suitable for off-shore oil and gas drilling and other operations comprising a cantilever system where a drill floor is located above for drilling over a drill area; further characterized in that in applying BCS, it can be broken down in parts for re-attachment for in-situ installation thus making the individual components lighter resulting ease of handling and transportation, and ,

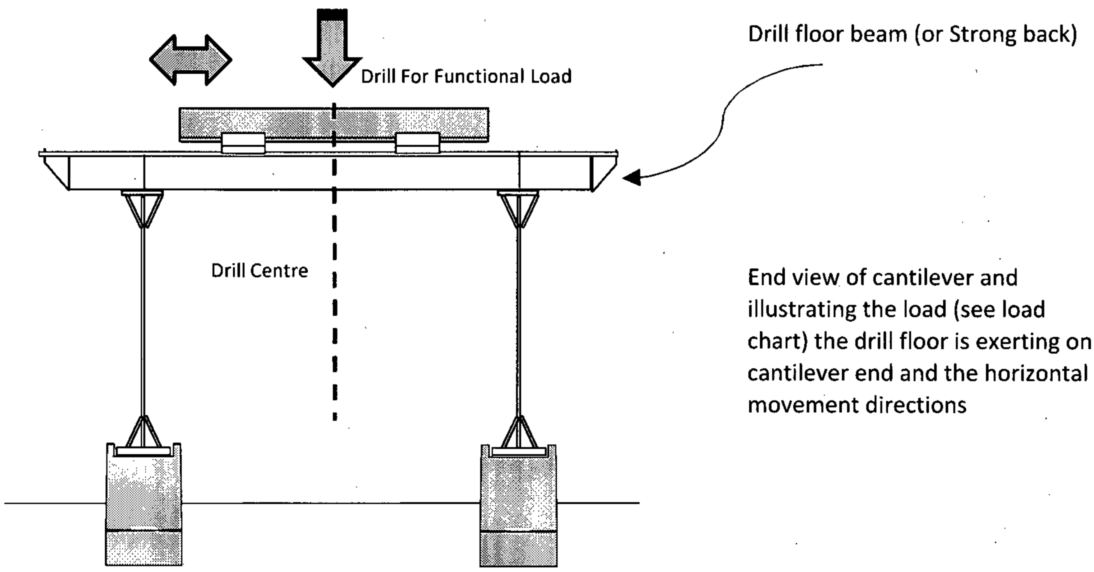
(7) A self elevating drilling rig **(Unit)** suitable for off-shore oil and gas drilling and other operations comprising a cantilever system; further characterized in that the application of the Invention is competitive with non-conventional cantilever systems such as X-Y or Rotating systems.



Perspetive view

Elevation View

Figure 1a - typical conventional cantilever



End view of cantilever and illustrating the load (see load chart) the drill floor is exerting on cantilever end and the horizontal movement directions

Cantilever extended

Outreach		Transverse travel				
		Centre	1.5m	3.0m	4.5m	5.5m
(ft)	(m)	(mt)				
25	7.62	1200	1200	1100	950	850
30	9.14	1200	1200	1060	880	760
35	10.67	1200	1150	980	800	670
40	12.19	1200	1100	900	720	580
45	13.72	1200	1020	810	640	510
50	15.24	1100	900	720	560	440
55	16.76	1020	860	660	480	380
60	18.29	940	780	600	430	320
65	19.81	870	710	560	380	270
70	21.34	780	650	510	330	230
75	22.86	700	530	380	250	180

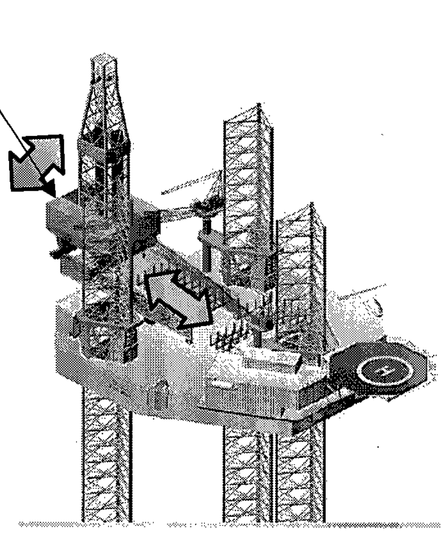


Figure 1b - typical conventional cantilever loading chart

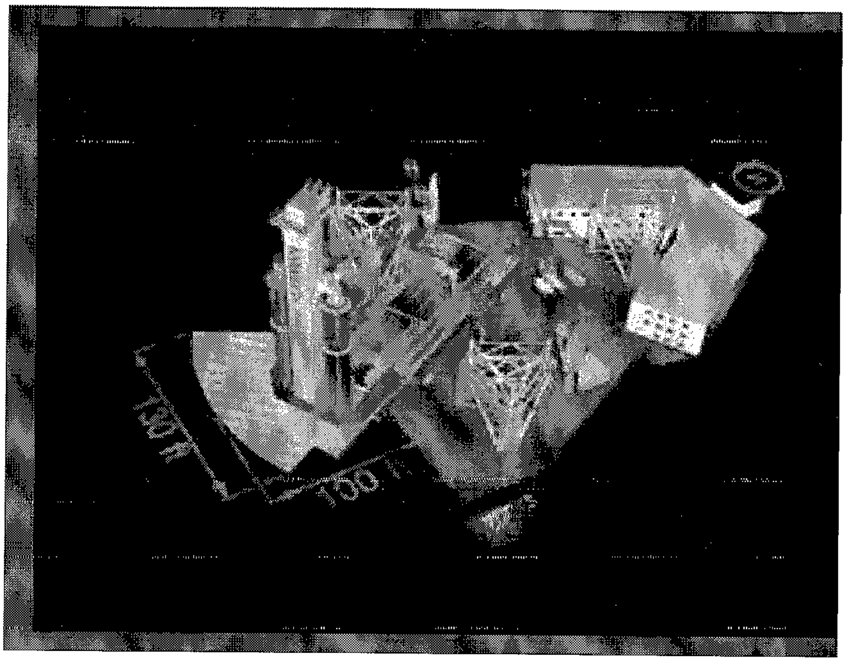


Figure 2a - Rotating cantilever - drill floor is fixed on cantilever

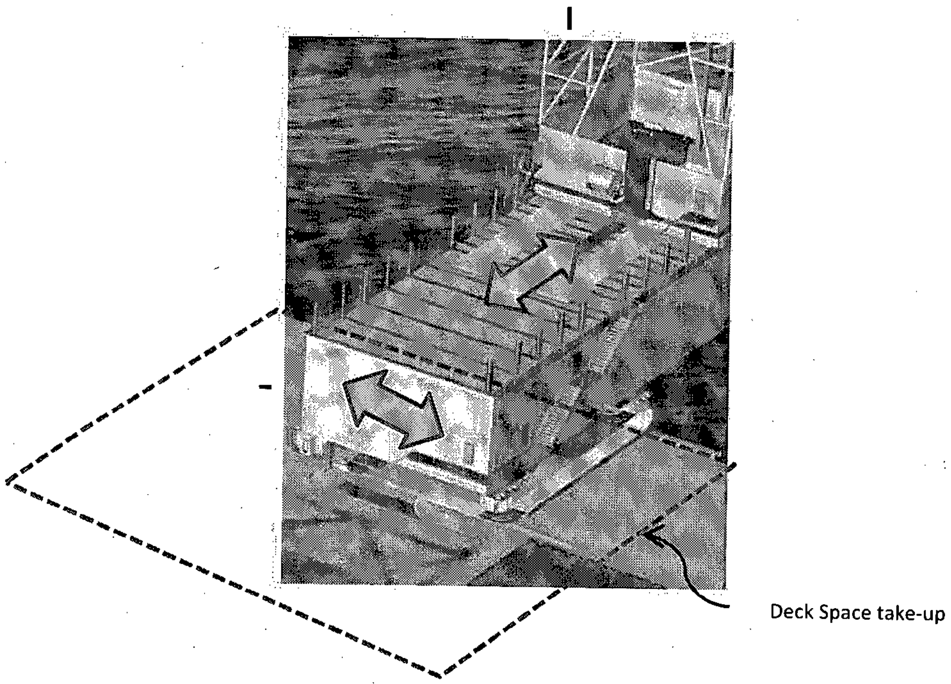


Figure 2b - " X-Y" cantilever - drill floor is fixed on cantilever

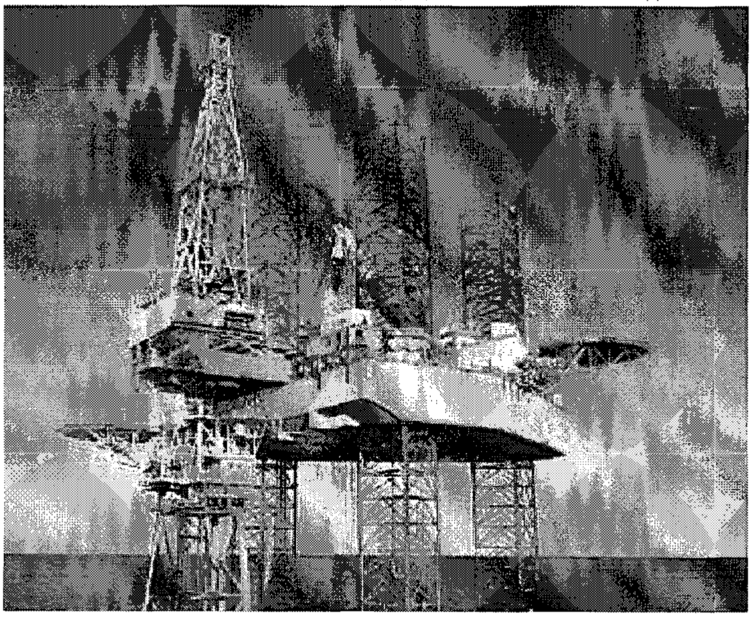


Figure 2C - Jack Up Rig with conventional cantilever

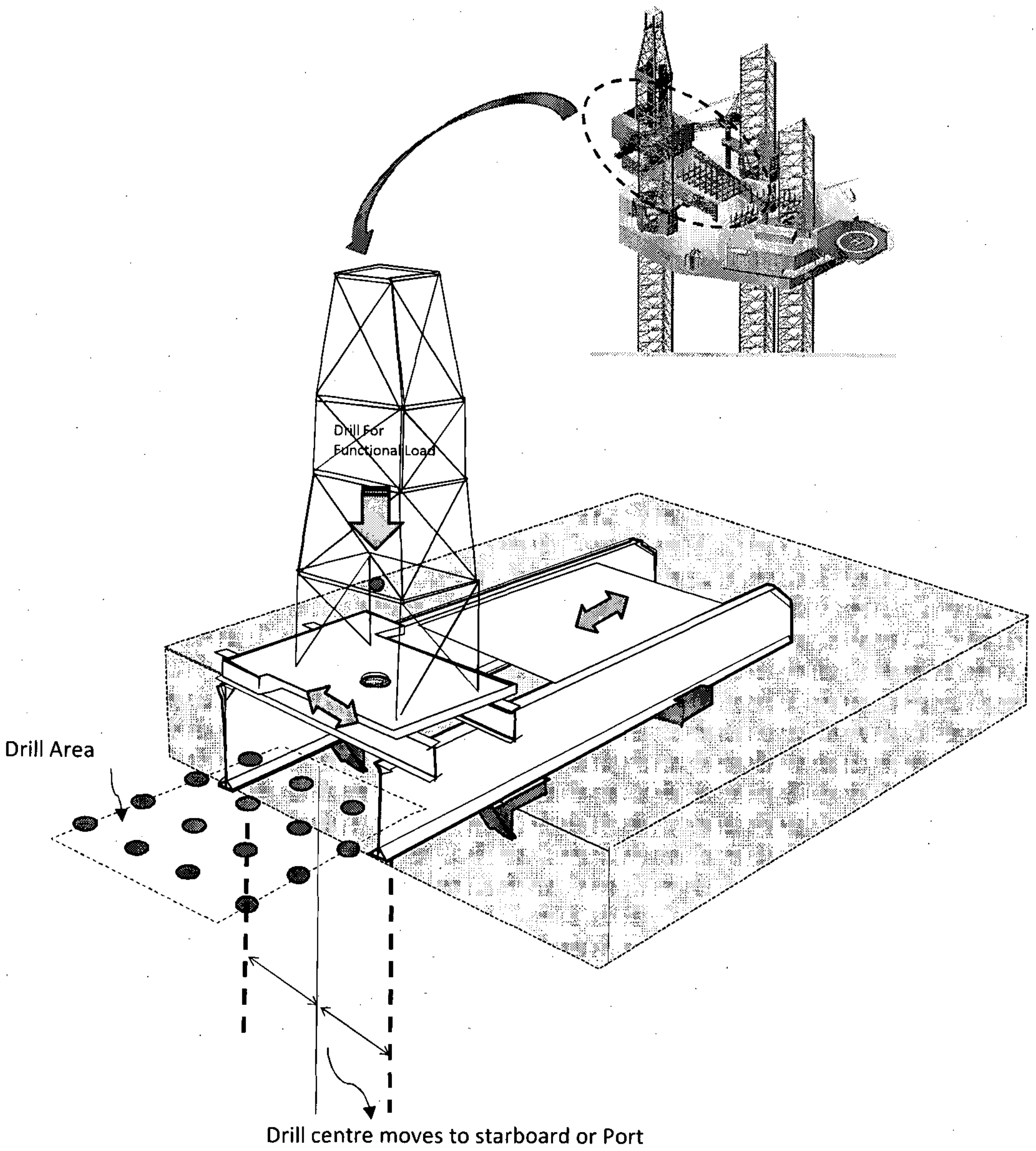


Figure 3.0 - Drill Area Limit

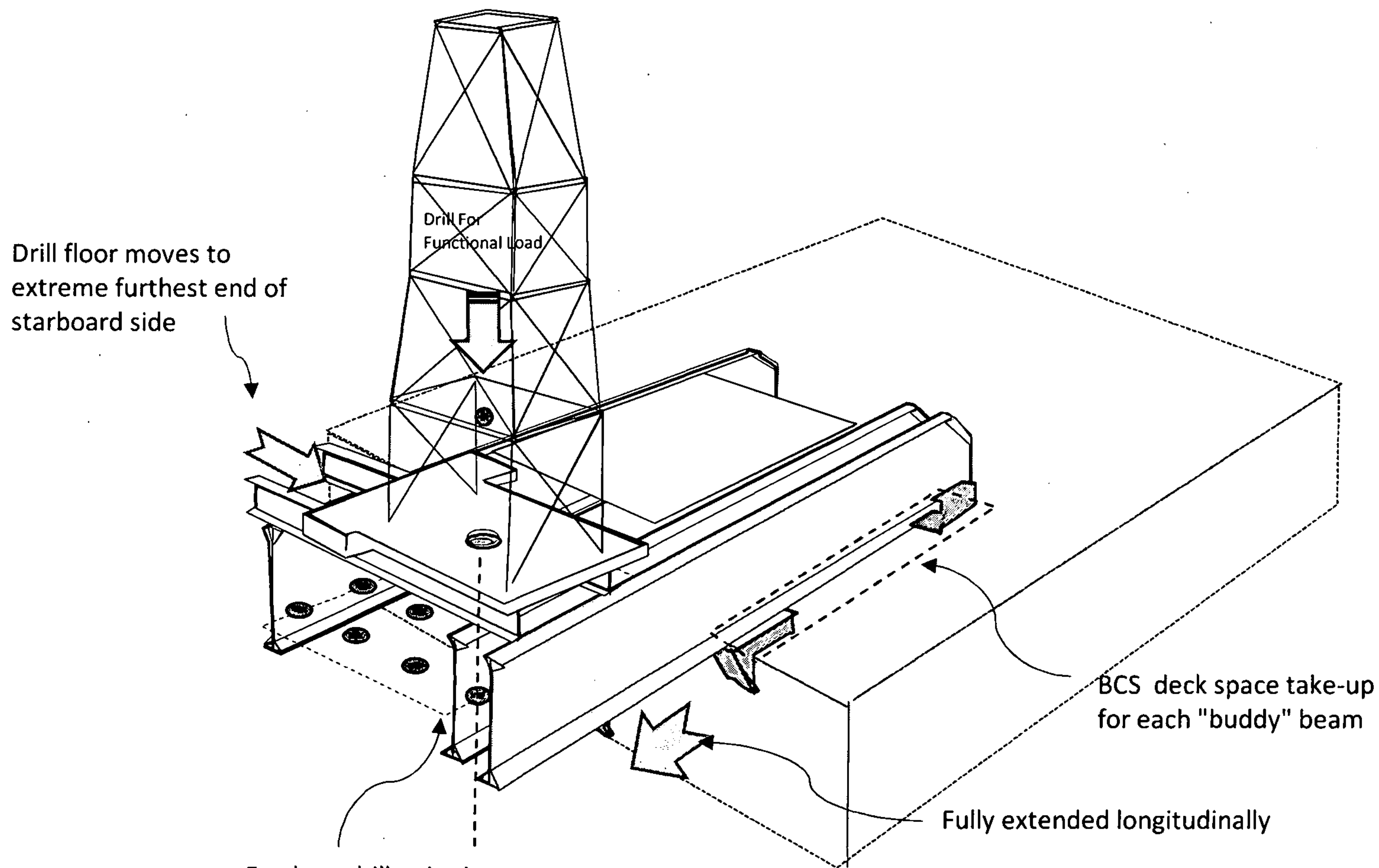


Figure 4a - Buddy Cantilever System
("Buddy" installed to act as double-beam to the starboard side of conventional cantilever)

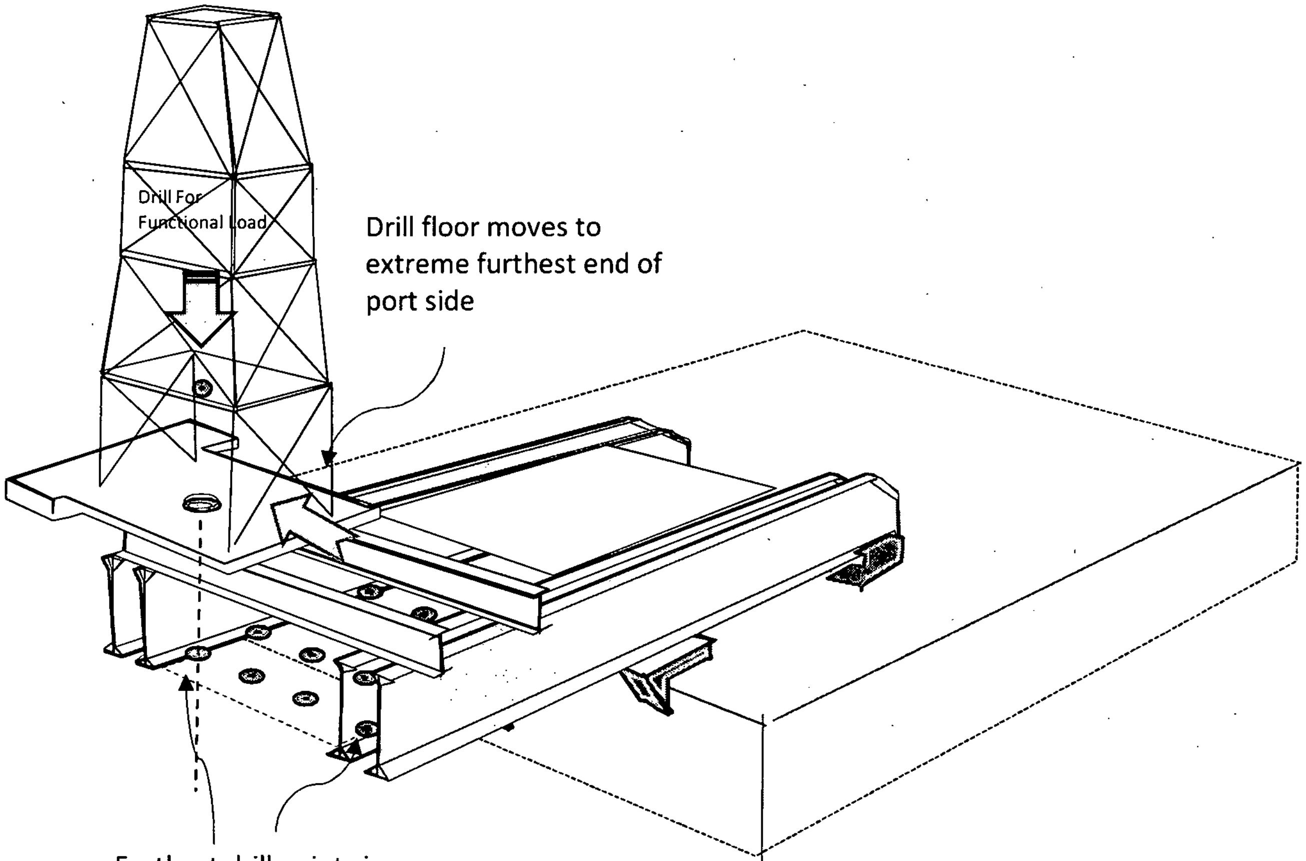
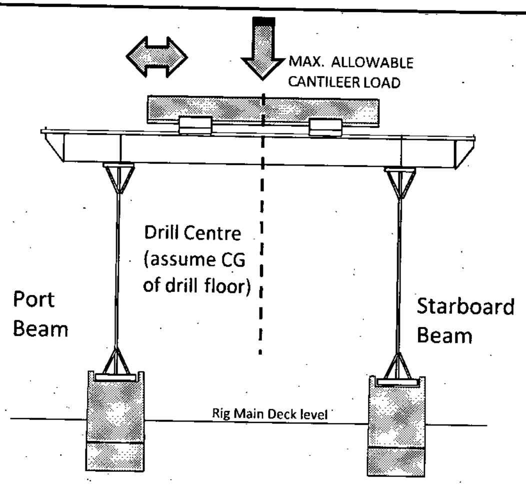
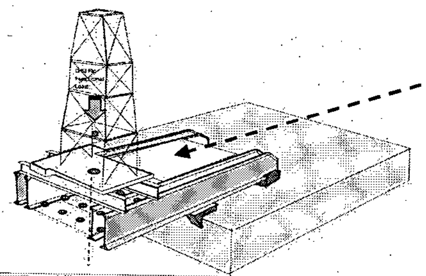
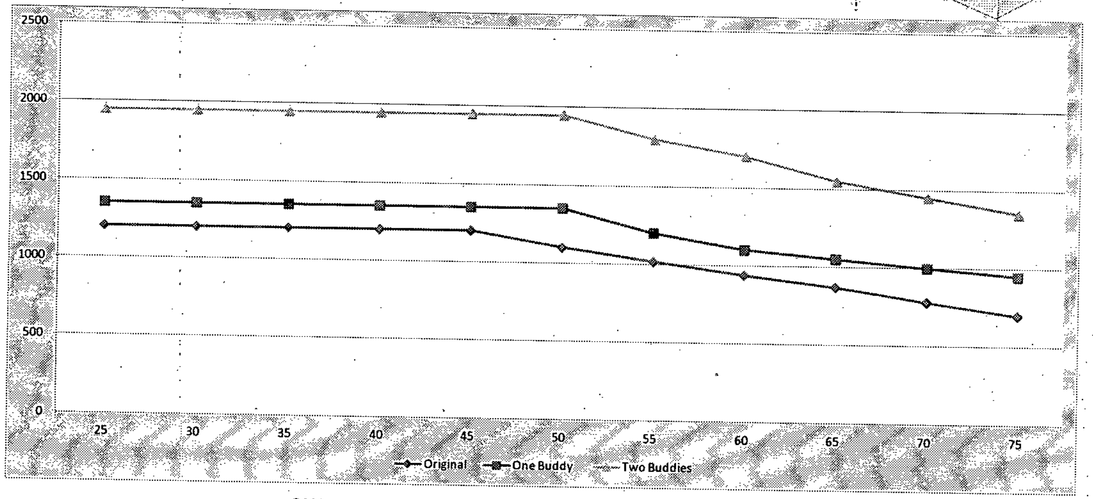


Figure 4b - Buddy Cantilever System
("Buddy" installed to act as double-beam to
the port and starboard sides of conventional cantilever)



Drill floor centre moves along rig centre



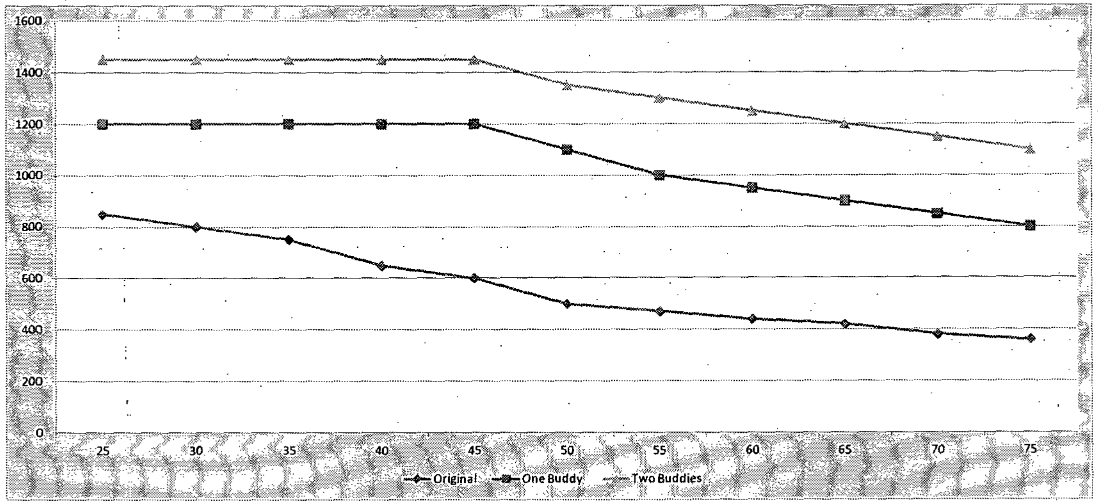


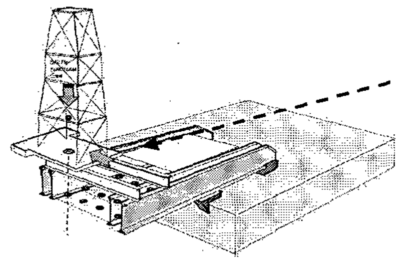
CANTILEVER TOTAL LOAD CAPACITY CHART

Drill Centre on rig longitudinal centre line moving out from rig transorr

	25	30	35	40	45	50	55	60	65	70	75
Original	1200	1200	1200	1200	1200	1100	1020	940	870	780	700
One Buddy	1350	1350	1350	1350	1350	1350	1200	1100	1050	1000	950
Two Buddies	1950	1950	1950	1950	1950	1950	1800	1700	1550	1450	1350

Figure 5a - Buddy Cantilever System Loading Improvement (estimated) - Drill floor centre moves along rig centre





CANTILEVER TOTAL LOAD CAPACITY CHART

Drill Centre in drill envelop Port or Starboard extreme longitudinal line moving out from rig transon

	25	30	35	40	45	50	55	60	65	70	75
Original	850	800	750	650	600	500	470	440	420	380	360
One Buddy	1200	1200	1200	1200	1200	1100	1000	950	900	850	800
Two Buddies	1450	1450	1450	1450	1450	1350	1300	1250	1200	1150	1100

Figure 5b - Buddy Cantilever System Loading Improvement (estimated)

(Drill floor centre extreme port when cantilever skids out)

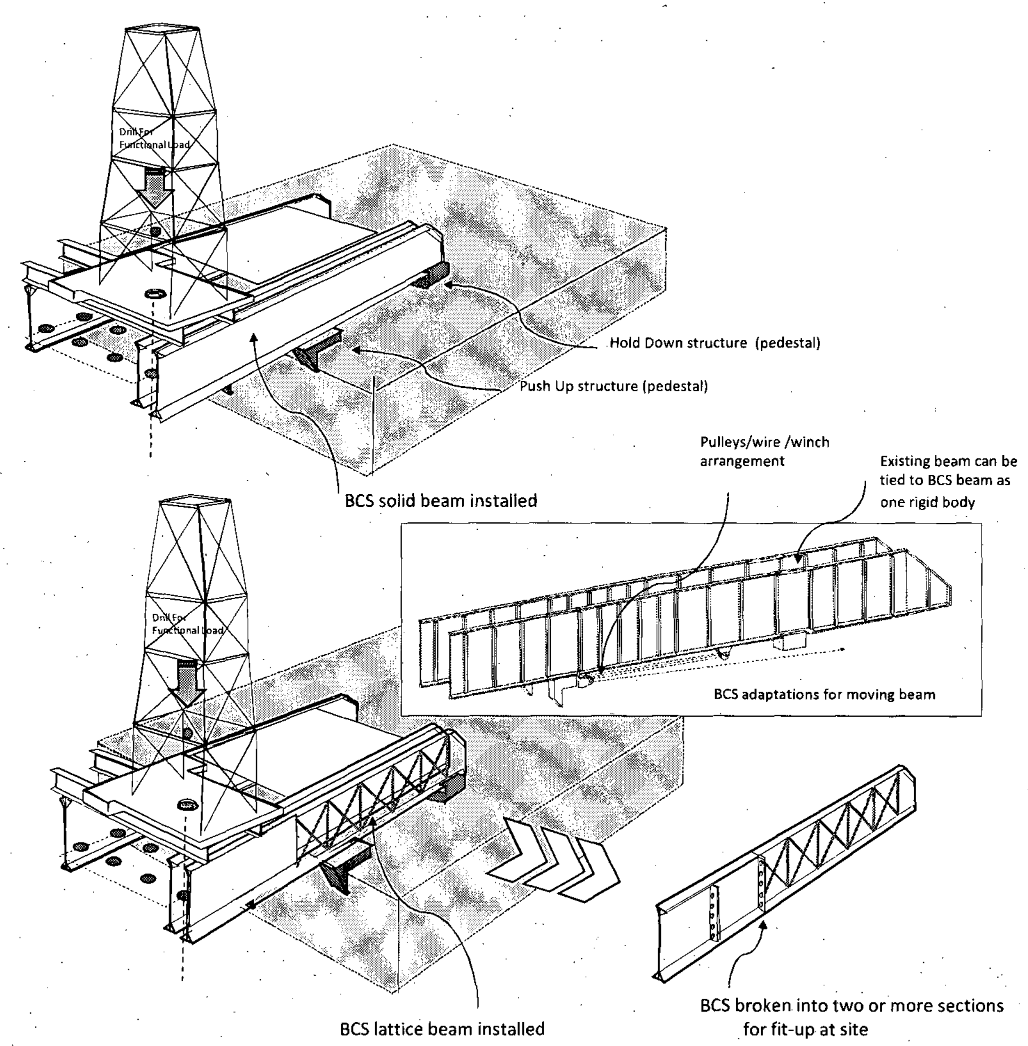


Figure 6.0 - Variations of BCS beam design under one concept

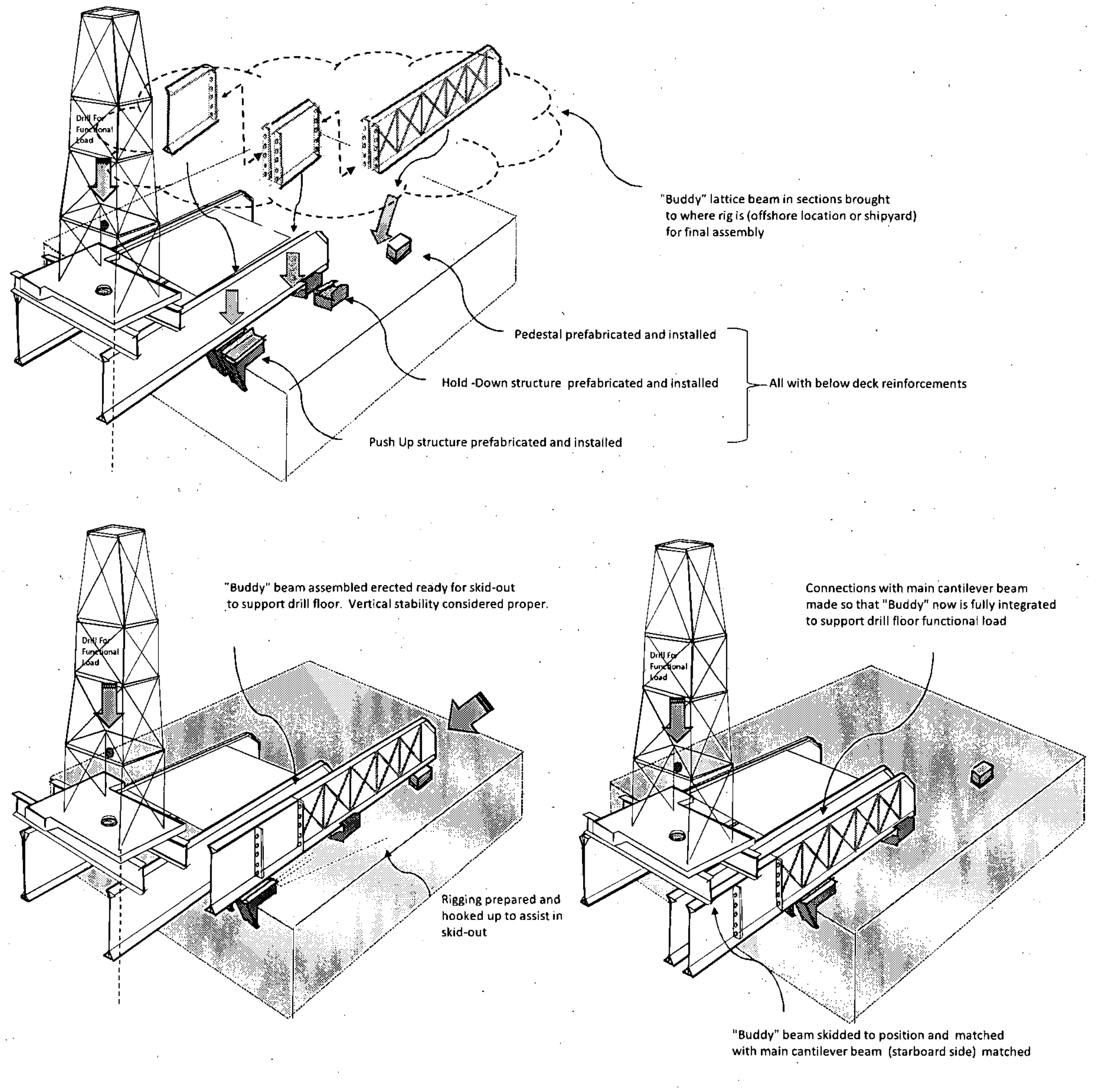
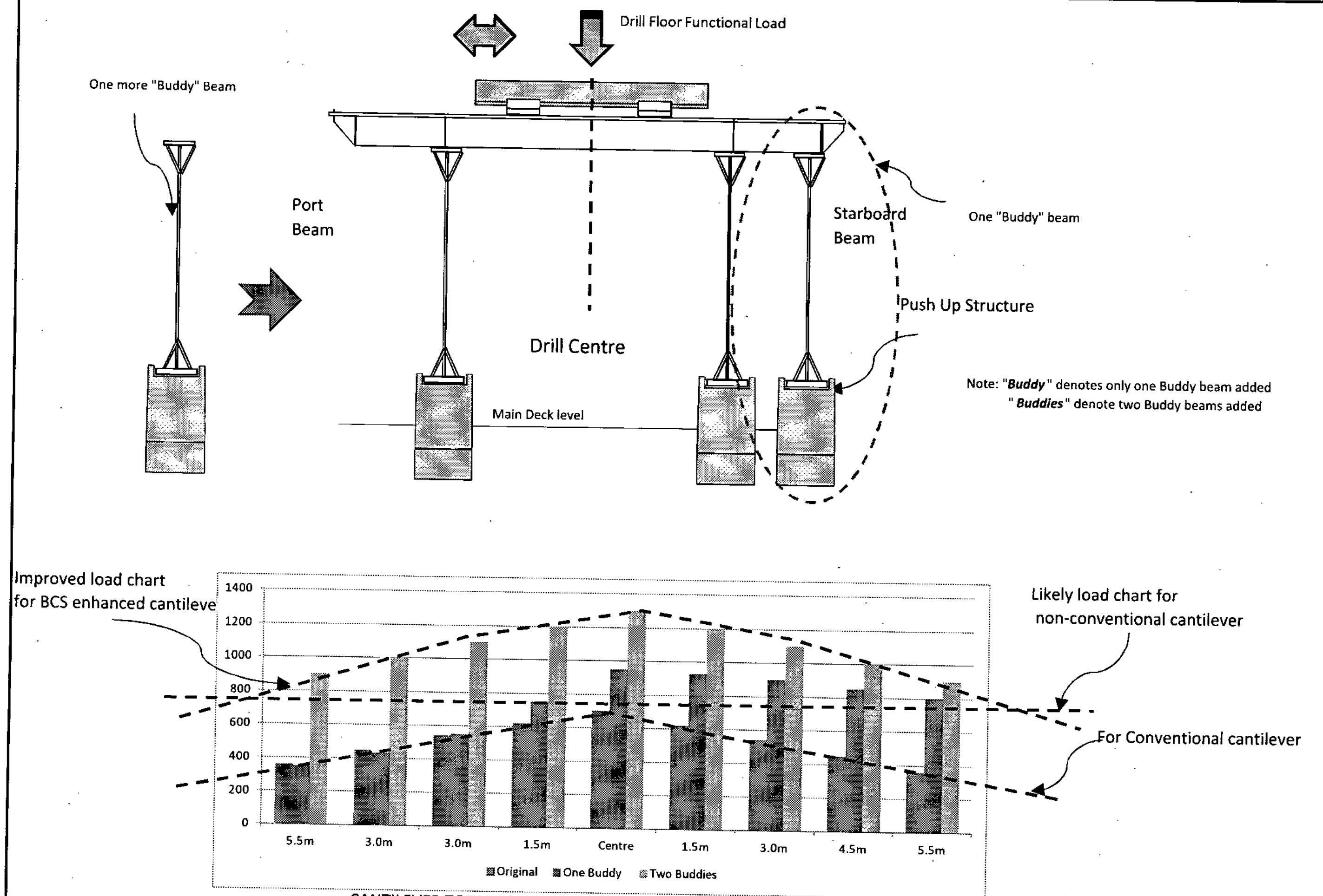


Figure 7.0 - Adaptation and Installation of BCS (New or Existing JU Rigs)



CANTILEVER TOTAL LOAD CAPACITY CHART (*fully extended*)

Drill Centre travelling transversely when cantilever is fully extended out from rig transom

	5.5m	3.0m	3.0m	1.5m	Centre	1.5m	3.0m	4.5m	5.5m
Original	360	450	540	620	700	620	540	450	360
One Buddy	350	430	550	750	950	930	900	850	800
Two Buddies	900	1000	1100	1200	1300	1200	1100	1000	900

(Port) (Starboard)

Figure 8.0 - Cantilever Load Chart at Max. Outreach (estimated)

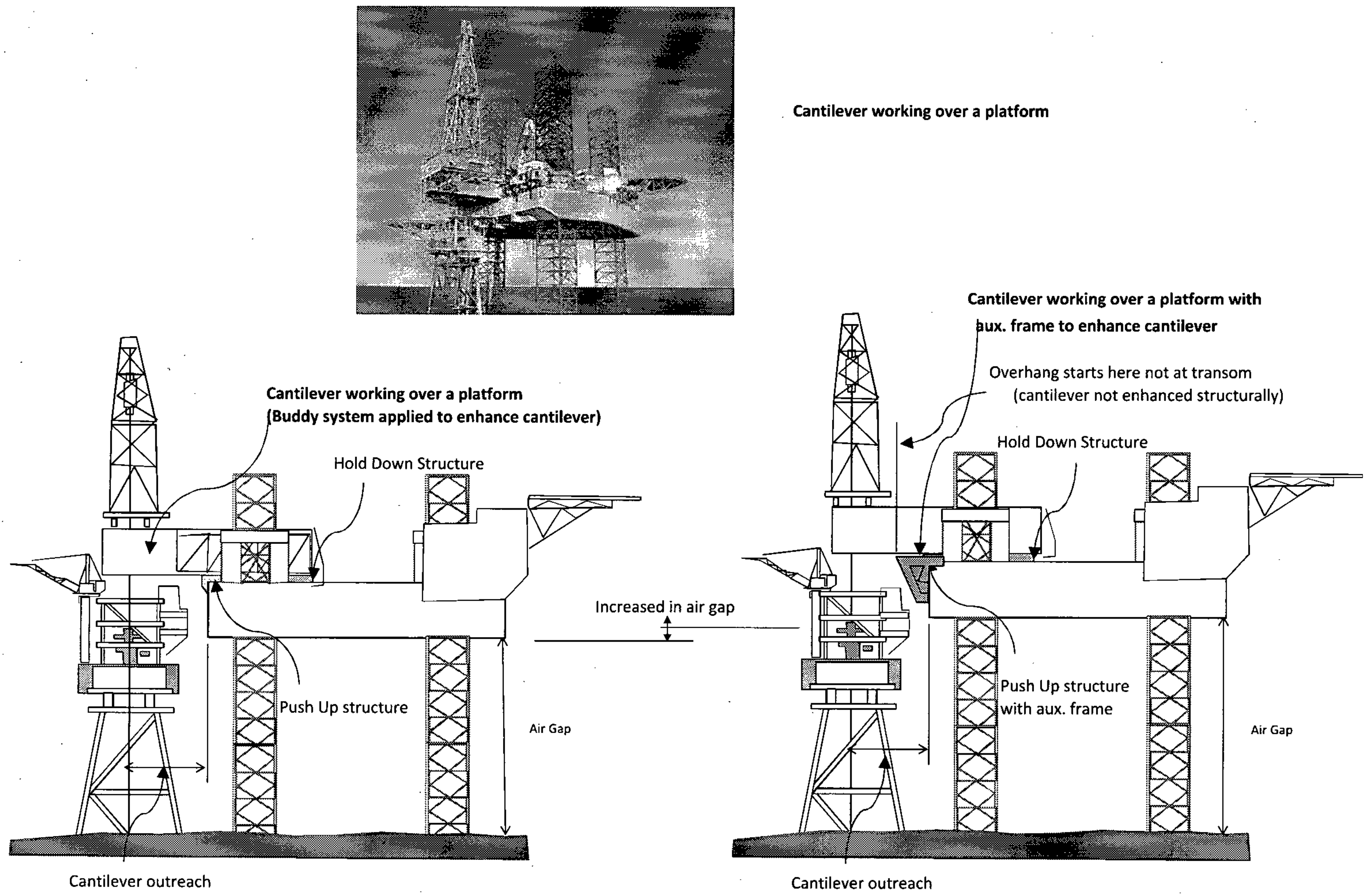


Figure 9.0 Cantilever in work-over mode

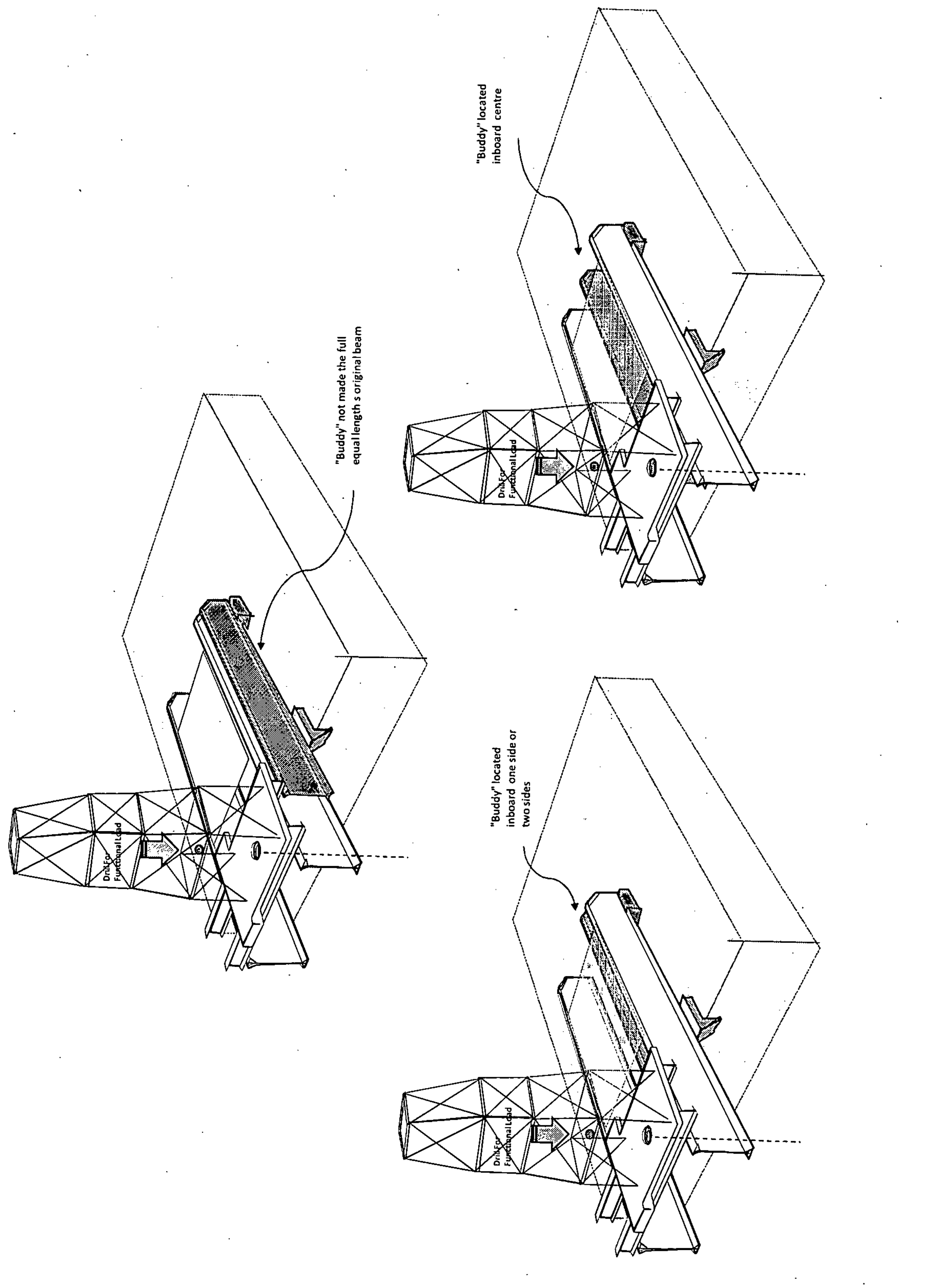


Figure 10 - Variations of BCS (New or Existing JU Rigs)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG2013/000090

A. CLASSIFICATION OF SUBJECT MATTER

E21B 7/128(2006.01)i, E21B 15/02(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E21B 7/128; E02D 21/00; E02B 17/08; E02B 1708; E02B 1700; E21B 15/02; E21B 19/00; E02B 17/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: drilling rig, cantilever, drill floor, load carrying ability, drill area, and duplicating

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4401398 A (REMSON, DONALD R.) 30 August 1983 See column 3, line 32 - column 5, line 17, column 5, lines 62-68, and figures 1-6.	1-7
A	US 6171027 Bl (BLANKESTIJIN, ENRICO PEDRO) 09 January 2001 See column 3, line 45 - column 4, line 8 and figure 1.	1-7
A	US 7083004 B2 (R0ODENBURG, J0OP et al.) 01 August 2006 See column 6, lines 16-25, column 6, line 64 - column 7, line 19, and figures 1-2, 9-11, 15.	1-7
A	WO 2012-036630 Al (NG, KHIM KIONG) 22 March 2012 See abstract, claim 1, and figures 1-2.	1-7
A	US 4224005 A (DYSARZ, EDWARD D.) 23 September 1980 See column 5, lines 21-60 and figures 6-9.	1-7

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 October 2013 (11.10.2013)	**11 October 2013 (11.10.2013)**

Name and mailing address of the ISA/KR
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea
Facsimile No. +82-42-472-7140

Authorized officer
LEE Jong Kyung
Telephone No. +82-42-481-3360

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/SG2013/000090

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US 6171027 Bl	09/01/2001	None	
US 7083004 B2	01/08/2006	AU 2003-301331 Al	04/05/2004
		CN 100504023 C	24/06/2009
		CN 1705814 A	07/12/2005
		EP 1583884 Al	12/10/2005
		US 2004-151549 Al	05/08/2004
		WO 2004-035985 Al	29/04/2004
WO 2012-036630 Al	22/03/2012	SG 179303 Al	27/04/2012
US 4224005 A	23/09/1980	None	