

CCS PERFORMANCES AND SERVICES ON BULK CARRIER

CCS
CHINA CLASSIFICATION SOCIETY
中国船级社

Overview

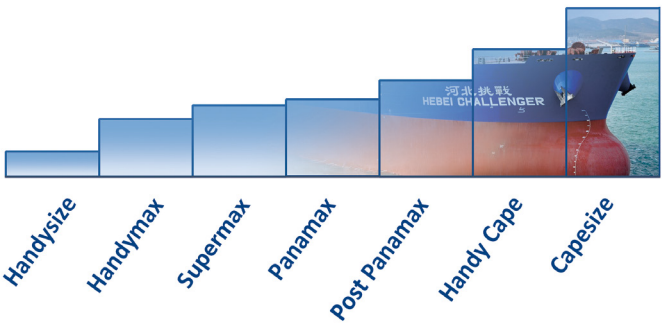
By sticking to the policy of "building first-class international classification society with own characteristics and with technology as the foundation and credibility as the cornerstone", CCS improves continuously its image and value in the ore carrier sector through advanced technology and quality service and is widely and highly recognized by the industry.

In recent years, CCS has carried out in-depth technical research on ore carriers with regard to structural safety, easy loading, ore (water content) feature, natural gas power system ready, vibration and noise, shafting alignment, emission control solutions, structural arrangement optimization and energy efficiency optimization, etc. These techniques have been applied onboard ships and helped to upgrade the technical service capability of ore carriers. A group of advanced ore carriers have been classed with CCS.

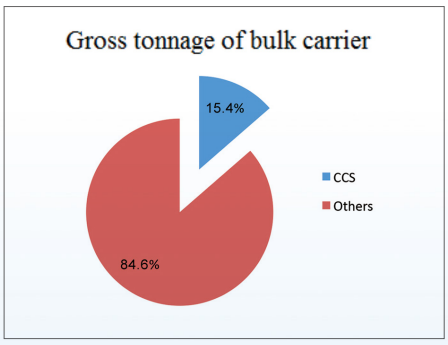
By committing to the mission of "safety, environmental protection and creating value for clients and society" and based on over 90 offices distributed across the globe, CCS provides 7 X 24 survey and technology support services to ship owners. Relying on its highly efficient service system structure, CCS continuously provides comprehensive support for conducting survey activities, safeguarding ship safety and emergency response to accidents. CCS has continuously achieved outstanding performance in three main MoUs and witnessed healthy and steady increase of its fleet size.

CCS Bulker fleet and performance

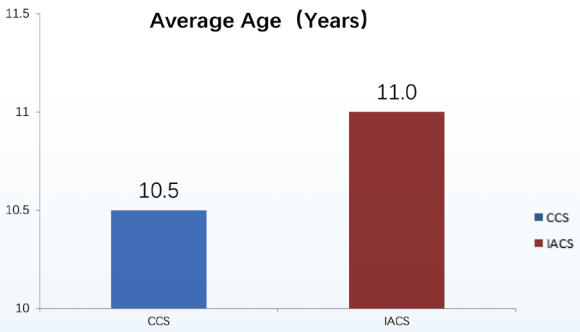
1) Full coverage of ship type: Ship types of all deadweights from Handysize type to Capesize type



2) Large size of fleet: Gross tonnage accounts for 15.4% of IACS bulk carrier fleet, the size and increase speed lead among IACS fleet



3) Low average age: Average 10.5 years, lower than the average age of IACS bulk carrier fleet



4) Application of new technology, enhance technical capabilities of CCS bulk carriers: In Dec 2017, the world's first intelligent bulk carrier MV "Great Intelligence" was delivered.



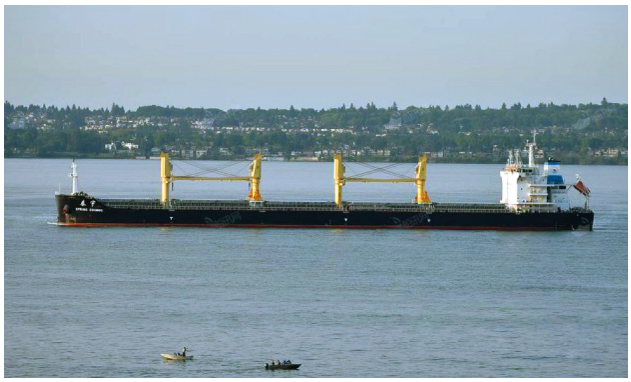
208,000DWT Bulk Carrier
(Guang Heng Hai)



180,000DWT Bulk Carrier
(Hebei King)



82,000DWT Bulk Carrier
(Hua Hai Hang 3)



64,000DWT Bulk Carrier
(SPRING COSMOS)



38,800DWT Bulk Carrier
Typical Bulk Carrier classed with CCS

Category and characteristics of ship types

◆ Category of ship types

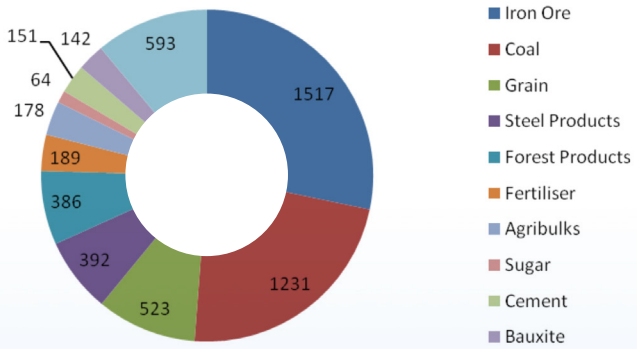
◎ Bulk carriers are divided into the following types according to the tonnage:

- Handysize bulk carrier: carries from 10,000 to 65,000 ton, among which those carrying over 40,000 tons are called Handymax bulk carrier. Handysize bulk carrier has moderate dead weight capacity and is well adapted to the course, canal and port and mostly equipped with cargo handling gear, the operation is convenient and flexible.
- Panamax bulk carrier: The largest bulk carrier which may pass the Panama Canal under full loading condition, with a length overall of up to 274.32 m and a beam of up to 32.6 m, carrying from 60,000 to 75000 tons. With the broadening of the Panama Canal, bulk carrier with larger main dimension and tonnage may pass the Canal and these types of ships are called Post-Panamax bulk carrier.
- Capesize bulk carrier: Bulk carrier over 170,000 DWT, carrying mainly the iron ore. Capesize ships are too large to pass the Panama Canal and Suez and needed to go around the Cape of Good Hope, so they are called Capesize.

◎ There are following types of bulk carriers according to the largest size designed based on the characteristics of route and port:

- Kamsarmax: the largest vessel able to enter the Port of Kamsar (Republic of Guinea), length of 229 meters, the dead weight tonnage about 82,000 DWT;
- Dunkirkmax: the largest vessel able to enter the Port of Dunkirk, width of 45 m; dead weight tonnage 175,000 DWT approx.;
- Newcastlemax : the largest vessel able to enter the port of Newcastle, Australia, width 50 meters, and maximum length of 300 meters , dead weight tonnage 210,000 DWT approx.;

Nowadays, the gross tonnage of global bulk fleet accounts for approximately 35% of the world's fleet, undertaking the transportation of about 52% dry and bulk cargoes of all seaborne trade.



Composition of global dry and bulk cargoes carried by sea in 2021
(million tons)

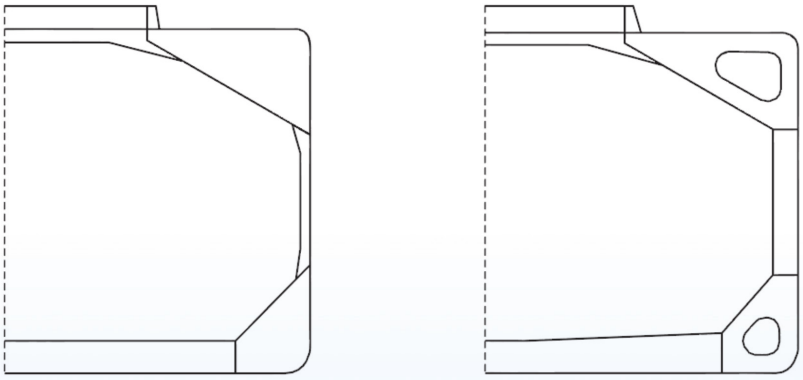
Global bulk fleet and cargoes carried

Ship type	Ships in operation	Major cargoes carried
Capesize (DWT >100k)	1920 ships approx. 378.7 million DWT	Iron ore, coal
Panamax (DWT from 65k to 100k)	2935 ships approx. 237.5 million DWT	Iron ore, coal grain/ aluminum bauxite
Handymax (DWT from 40k to 65k)	3936 ships approx. 221.6 million DWT	Coal/grain/steel cement/ phosphate rock rice/sugar/wooden product nickel Ore / sulphur /salt etc.
Handysize (DWT from 10k to 40k)	3953 ships approx. 111.2 million DWT	

◆ Characteristics of ship type

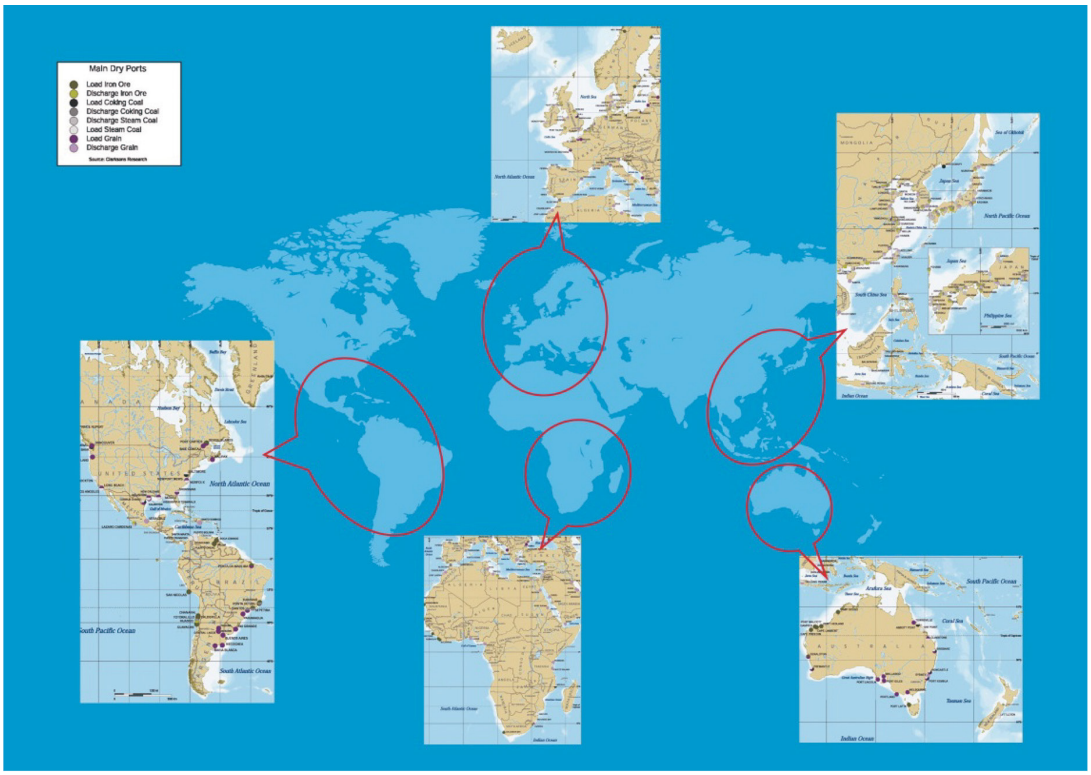
◎ Common characteristics of typical transverse section of bulk carriers are as follows:

- Large opening, single deck and double bottom
- Topside tank : shorten the surface transverse width of cargo and reduce the transverse movement and heeling moment of cargo
- Bottom side tank: sloping plate of bottom side tank is helpful to collect the cargoes during unloading and enhance unloading efficiency
- Single side or double side: transverse framing system is adopted in single side structure; the vertical arrangement of web avoids the accumulation of cargoes; the inner wall of double side structure is the smooth plane bulkhead so that it is easy to clean the hold
- Corrugated transverse bulkhead: the channel is arranged upright and top stool and lower stool are fitted to facilitate the cleaning of hold



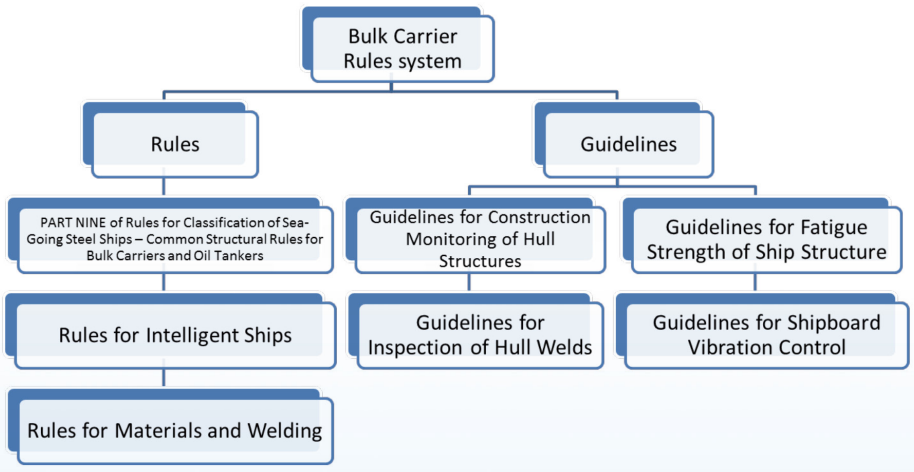
Typical transverse section of bulk carrier

◆ Major ports of call of bulk carrier around the world



Rules and calculation software

◆ Rule system



◆ Calculation software

CCS released integrated calculation software which is efficient, accurate, friendly and of high stability to provide fast and effective calculation tools for the design and structural strength assessment of ship and to guarantee the safety of ship's structure.

- CSR rules calculation : COMPASS-SDP
- CSR direct calculation : Compass-CSR-DSA
- Other requirements : Compass-Rules

Character of classification and class notation

★ CSA Bulk Carrier; CSR; BC-A; Holds Nos. 2, 4, 6 & 8 may be Empty; COMPASS(R,D,F); Grab[35]; Loading Computer(S,I,G); ESP; CM; PSPC(B); In-Water Survey ; i-Ship(N,M,E,I)

★ CSM AUT-0; SCM; G-ECO(CDx, BWM(T)); Dual Fuel; G-EP(GPR)

Class notation	Remarks
Bulk Carrier	Class notation for bulk carrier
CSR	Ship designed and constructed in accordance with Common Structural Rules
BC-A	Bulk carriers are to be assigned this notation, provided they ① are designed to carry dry bulk cargoes of density 1.0 t/m3 and above; ② have specified holds empty at maximum draught; ③ have BC-B requirements included in loading conditions
Holds Nos. 2, 4, 6 & 8 may be Empty	Holds Nos. 2, 4, 6 & 8 may be empty at maximum draught
COMPASS	For ships the design of which has been checked using CCS COMPASS-Structure software, one or more of the following suffixes R, D and F are to be added. Meanings of the suffixes are as follows: R: for ships the check of which against rules has been performed using COMPASS-Structure; D: for ships of which hull structure direct calculations have been performed using COMPASS-Structure; F: for ships of which hull structure fatigue strength assessment has been performed using COMPASS-Structure
Grab [35]	Strengthening of inner bottom plating, lower strake of hopper tank sloping plate and transverse lower stool plating for holds designed for loading/unloading by grabs having a maximum weight up to 35 tons
Loading Computer	Ships provided with approved loading computers are to be assigned this notation, with one or more of suffixes OA, S, I and D being added thereafter. Meanings of the suffixes are as follows: OA: Capable of calculating optimal trim curve in each loading condition and creating optimal energy-saving loading plan by automatic optimization; S: Capable of calculating and checking hull strength under various loading conditions; I: Capable of calculating and checking intact stability; D: Capable of calculating and checking damage stability OA, S, I and D can operate both separately and together

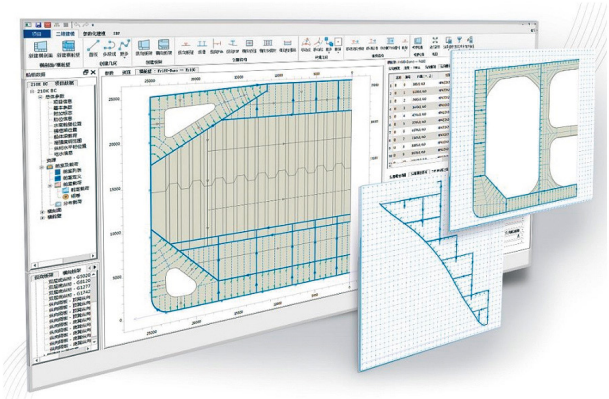
Class notation	Remarks
ESP	Enhanced survey programme. This notation is required for bulk carriers engaged on international voyages.
CM	Ships for which the control (Construction Monitor) of structural precision at critical locations of hull (including alignment, fitting-up, edge treatment and technological standards) is in accordance with an approved plan.
PSPC	Ships of which specific spaces comply with IMO Performance Standard for Protective Coatings may be assigned this notation, with one or more of suffixes B, C and V being added thereafter. Meanings of the suffixes are as follows: B: protective coatings applied in dedicated seawater ballast tanks of all types of ships; C: protective coatings applied in cargo oil tank spaces of crude oil tankers; V: protective coatings applied in void spaces of bulk carriers and oil tankers. Note: B, C and V can operate both separately and together
In-Water Survey	For ships suitable for in-water surveys, this notation may be assigned
i-Ship	Intelligent ship is a development trend in shipping industry and one or more notations such as N, H, M, E, C and I is affixed, meaning: N: intelligent navigation; H: intelligent hull; M: intelligent machinery; E: intelligent energy efficiency management; C: intelligent cargo management; I: intelligent integration platform
AUT-0	Main propulsion machinery remotely controlled from BCS, machinery space including CCS periodically unattended
SCM	This notation may be assigned to oil-lubricated or water-lubricated propeller shafts fitted with approved shaft seals
Dual Fuel	This notation may be added for ships which not only use natural gas as fuel but also burn fuel oil, or burn fuel oil and natural gas fuel at the same time
G-ECO, G-EP	Green ships

Key technology

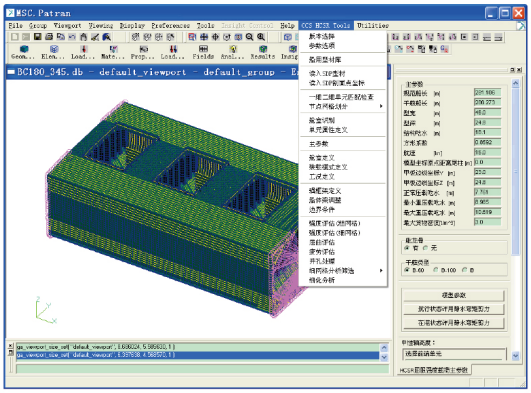
◆ Structural safety

a) Assessment of structural strength

The structural strength of hull of bulk carrier may be assessed comprehensively using CCS calculation software so as to guarantee the structural safety.



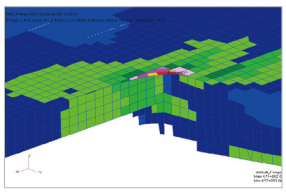
Rules calculation Compass-SDP software



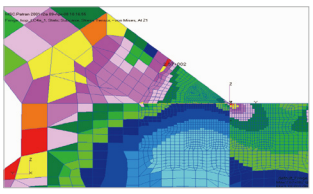
Direct analysis Compass-CSR-DSA software

b) Critical area

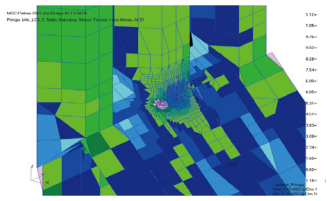
The stress in way of critical areas is controlled through FE analysis in the phase of design and plan approval by identifying the critical areas of hull structure. In construction stage, the construction quality of critical areas is controlled. In operation stage, special attention is paid to the survey of critical areas.



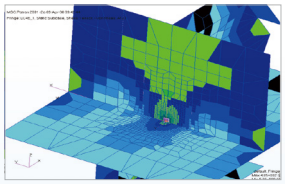
Hatch corner



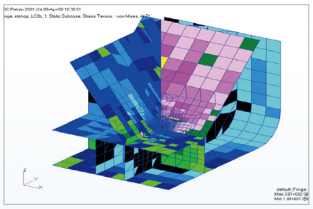
Hopper tank knuckle



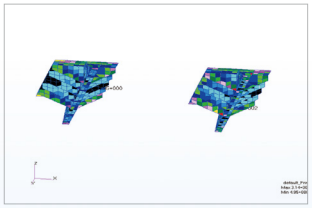
Intersection of transverse bulkhead and lower stool



Central girder and lower stool sloping plate



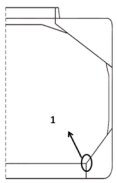
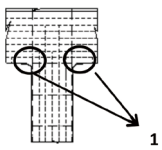
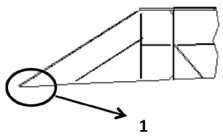
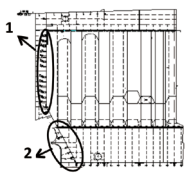
Intersection of lower stool sloping plate, hopper tank sloping plate and inner bottom

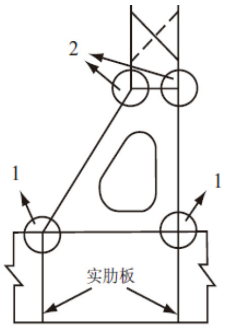
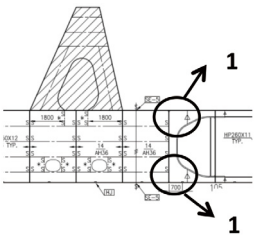


Intersection of deck girder and transverse bulkhead

c) Construction monitoring

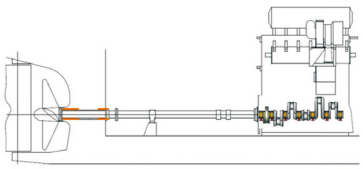
The quality of construction of hull determines the operational reliability and the service life of structure. The monitoring of critical locations is carried out for the purpose of controls on alignment, fit-up, groove preparation and workmanship to the critical locations of the relevant hull structures, to ensure that the critical locations are built to both relevant quality standard and approved construction procedures.

Critical locations	Major controlling measures	
	Location 1	a. to confirm the utilization of material b. to confirm weld grooves and gaps c. to inspect the structural alignment with check line method and template method d. to confirm the locating quality, welding environment and welding sequence e. to polish welds of fatigue nodes in way of web frame f. visual inspection and NDT after welding
	Location 1	a. to confirm the material in way of hatch corner b. to confirm the radiused shape of hatch corner c. to confirm that the edge of hatch corner plating is smooth d. to confirm the protective measures for hatch corner
	Location 1	a. to confirm the material and shape of toe b. to confirm the alignment of web and underdeck structure with check line method c. to confirm weld grooves and gaps d. to confirm welding environment e. visual inspection and NDT after welding
	Location 1	a. to confirm the alignment of plan bulkhead and corrugated transverse bulkhead b. to confirm weld grooves and gaps c. to confirm welding environment d. visual inspection after welding
	Location 2	a. to confirm the alignment of lower stool side plating with side tank structure b. to confirm the alignment of lower stool top plating, lower stool diaphragm with the side tank structure c. to confirm weld grooves and gaps d. to confirm welding environment e. visual inspection after welding

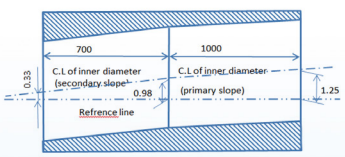
Critical locations	Major controlling measures	
	Location 1	a. to confirm the alignment of lower stool side plating with double bottom floor through check line method b. to confirm the alignment of lower stool vertical web with double bottom girder c. to confirm the connection between lower stool vertical web with inner bottom plating and lower stool side plating d. to confirm weld grooves and gaps e. to confirm welding environment f. visual inspection and NDT after welding
	Location 2	a. to confirm the alignment of corrugated bulkhead plating with lower stool side plating with check line method and template method b. to confirm the connection between lower stool vertical web with lower stool top plating c. to confirm weld grooves and gaps d. to confirm welding environment e. visual inspection and NDT after welding
	Location 1	a. to confirm the material and shape of bracket and connecting structure b. to confirm the alignment of bottom longitudinals, inner bottom longitudinals, bracket with local short girder c. to confirm the transition of bracket and longitudinals d. to confirm weld grooves and gaps e. to confirm welding environment f. visual inspection and NDT after welding

◆ Shafting vibration and alignment

Analysis and assessment of shafting alignment and vibration characteristics is carried out and technical support is provided on shafting arrangement and alignment procedures, so as to effectively avoid damage and overheating of shafting. Analysis of failure cause is also carried out and solutions are presented.





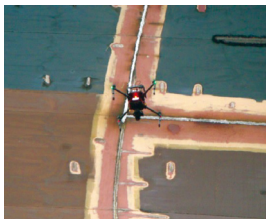




◆ Survey by means of unmanned aerial vehicle (UAV)

During ship surveys, UAVs may be used by CCS to take close-up photos, scanning hull structures automatically or by manual control. In this way, defect screening can be achieved through image recognition technology. UAV can be used as an alternative or supplementary way for survey of those hull structures that are not easy to be accessed or in areas of poor visibility, thus helping to improve survey quality and efficiency, increase survey safety and reduce cost.





Hotspot technology

◆ Cargo loading on main deck

In recent years, more and more demands for cargo loading on the main deck of bulk carriers appear in the shipping market. This may cause risks to the bulk carriers which are not originally designated for this purpose.

CCS can provide the technical supports and safeguard the cargo loading on main deck by checking

- Structure strength
- Stability
- Cargo Securing and etc.
- Sight line



◆ Intelligent ships

Ship intelligentizing can make ships more economical, more reliable, safer and more environmentally-friendly. In 2015 CCS released the *Rules on Intelligent Ships*, the first of its kind in the world, which have been applied on various ships.

Class notation for intelligent ships: i-Ship (Nx, Hx, Mx, Ex, Cx, Ix)

- N-- functional notation for intelligent navigation;
- H-- functional notation for intelligent hull;
- M-- functional notation for intelligent machinery;
- E-- functional notation for intelligent energy efficiency management;
- C-- functional notation for intelligent cargo management;
- I-- functional notation for intelligent integration platform
- x-- additional notation for optional function



Recommendation for intelligent bulk carrier: i-Ship (N, E, M, I)

In December 2017, intelligent 38.8k bulk carrier "DA ZHI" was delivered and assigned with i-Ship (N, E, M, I) class notation.

◆ Ship energy efficiency technology



Due to the double pressure of environment and operational cost, the shipbuilding and shipping industries have focused their attention on ship's energy saving and emission reduction. By means of evaluation of ship's resistance reduction and efficiency improvement technology based on experience, test and CFD, CCS can provide guidance on ship's weight control technology and carry out evaluation of comprehensive energy efficiency in full load and/or ballast and/or partial load conditions in accordance with ship type, logistics and route characteristics, including resistance reduction (including molded line optimization), efficient propelling system, energy conservation arrangement, lightship weight control, optimization of machinery equipment and system, best trim, application of new energy technology, on-line energy consumption intelligent management system for the purpose of improving ship's energy efficiency, saving energy and operational cost. CCS has successfully provided energy efficiency optimization plans to several types of bulk carriers.

◆ SOx & NOx emission control

As international conventions and relevant nations and regions specify stricter requirements for emission control of air pollution from ships, CCS has always been committed to research on various technologies and methods to effectively reduce SOx/NOx emission from ships.

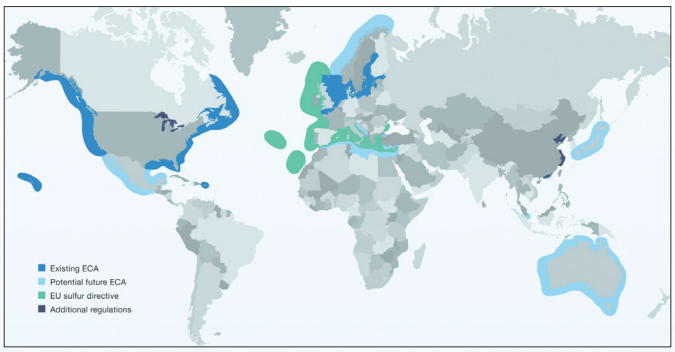
◎ **With regard to SOx emission requirements, there are the following solutions:**

- Low-sulphur fuel oil;
- Dual-fuel power system;
- Exhaust gas cleaning (EGC) system.

◎ **With regard to NOx Tier III requirements, there are the following solutions:**

- Low-pressure dual-fuel power system;
- Exhaust post-processing SCR system;
- Exhaust recycling EGR system.

To provide SOx and/or NOx emission control solutions to the clients through feasibility and economic analysis based on the characteristics of ship type and route; recommendations for coping with emission control may also be provided for ships in service.



a) Global ECAs

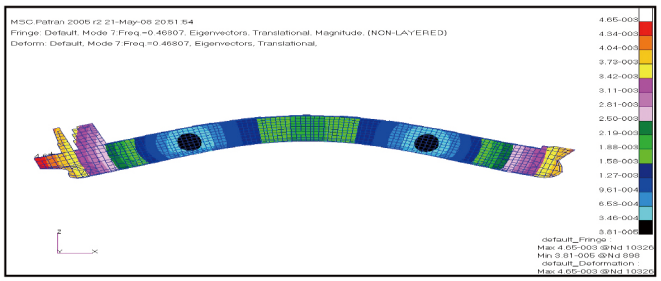


b) China ECAs

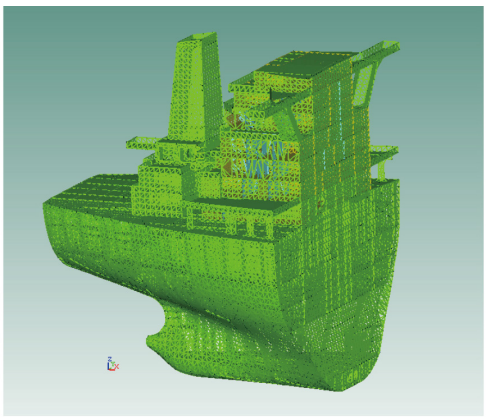
◆ Vibration and noise

Over vibration may cause fatigue damage to local structure or failure of machinery equipment, even the normal operation of ship, in addition to the adverse effect on personnel. CCS carries out real ship testing through advanced vibration analysis to provide the clients with solutions to effective control of hazardous vibration of hull.

In order to support the implementation of Rules for Onboard Noise Level, CCS provides the clients with solutions to noise reduction through noise prediction and assessment based on noise analysis.



Vibration analysis for the whole ship



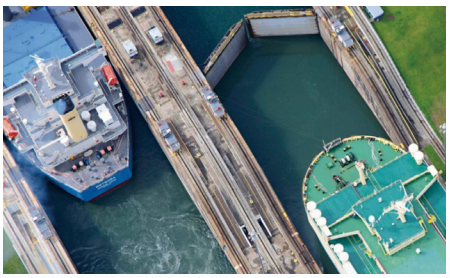
Engine room noise analysis

◆ Outlook of new Panamax

The dimension of the new locks, as summarized below, will have significant impact on the existing bulk carriers and as well, may trigger some new designs.

	Length (m)	Beam (m)	Draft (m)	Air Draft (m)
Old Panama Canal	289.6	32.31	12.4	57.91
New Panama Canal	366	51	15.2	57.91

For existing large bulk carriers, such as capsized, they may transit through the new Panama Canal directly with maximum draft of 15.2m. Therefore owners can arrange new navigation routes.



Furthermore, it may trigger some new designs fit for the new capacity of the Panama Canal. The new design will change the transport pattern of commodities with high or low density. It's estimated that the maximum deadweight of the new Panama bulk carrier is around 120,000 DWT, but considering the economical aspect, the vessels of 95,000 to 100,000 DWT are preferred.

CCS can offer technical support and service for ship owners on the development of new Panamax.

CCS ship type service:

◆ Joint development of ship type

Ship type is jointly developed in conjunction with the shipyard and designer. By making use of CCS advantage in information and technology, based on comprehensive information such as route, port and channel and by means of advanced technical rules, technical economic analysis, and structural and performance calculation analysis, effective technical solutions are provided in order to jointly develop top quality ship type.

◆ Optimization and upgrading of ship type

Reliable structural optimization and upgrading solutions are provided by means of scientifically reasonable quantitative and qualitative research and analysis based on current characteristics of ship type, so as to provide strong support for ship type upgrading, making the ship safer, more environmentally friendly, more economical and more efficient.

◆ Approval of ship type

Compliance evaluation is carried out on ship types provided by the shipyards and designers in accordance with agreed rules and conventions, and ship type approval certificate is issued to lay the foundation for ship type promotion and plan approval in the future.

◆ Recommendation of ship type

Excellent and reasonable ship type is recommended in accordance with the basic needs of the client and based on CCS ship type performance accumulation and advantage in technical experience, covering main scantling, structural arrangement, type selection of main engine, energy efficiency indicator, emission scheme and intelligence scheme.

◆ Technical training of clients

Based on the needs of the clients, CCS can provide comprehensive and customized technical training service related to rules, software and technical solutions.

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Contact information:

Technical support: Xu Wei
Tel: 021-61089265
E-mail: xuwei@ccs.org.cn

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