

Regulations and Utilizations for 3D Marine Cadastre in China

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Key words: marine cadaster, 3D marine cadaster, sea surface, sea water, seabed, overlay sea-use

SUMMARY

Marine developments and utilizations have attracted more attentions and various sea industries have developed in many sea areas in different forms. Challenges happen when marine use changes from sole use to multiple uses, especially different uses in different depths. To meet the requirements China has enacted and enforced several regulations to manage and register 3D marine cadaster.

Traditional 2D marine management treat the marine parcel as a full sole space from sea surface to bottom sea subsoil, which couldn't distinguish the different 3D space of sea surface, sea water, seabed and subsoil with different depths/elevations. So, without the 3D space description and 3D RRRs (rights, responsibilities and restrictions) in sea areas, it couldn't facilitate the 3D marine developments and utilizations.

To promote the developments of marine resources and sea areas, many regulations have enforced to give clear definitions in sea fields. State Oceanic Administration of China (SOAC) (part of Ministry of Natural Resources of China) issued the management regulation on sea area use about offshore wind farm in 2016 and put forward 3D sea with multiple layer registration and management to deal with submarine cable and site place that facilitated the development of offshore wind power. In 2019, the State Council of P.R.China motioned to explore 3D multiple-layer marine RRRs, and claimed that multiple-layer marine RRRs can be issued for sea surface/above, sea waterbody, seabed and sea subsoil in the Implementation Plan for the Comprehensive Reform of the Pilot Demonstration Zone for Building Socialism with Chinese Characteristics in Shenzhen (2020-2025) in 2020. These regulations have figured out 3D marine cadaster to resolve the conflicts of overlay sea use and cross sea use that happened in 2D manner. Two cases, including overlay sea use between over-sea bridge bases and sea tunnel, multiple jurisdictional management Shenzhen-Hong Kong Expressway will be analysed to illustrate 3D marine cadaster with multiple layer RRRs.

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1. INTRODUCTION

With the development of science and technology and the increase of human demand for marine resources, marine activities are becoming more and more frequent. Marine developments and utilizations have attracted more attentions and various sea industries have developed in many sea areas in different forms. The types of marine uses are rich and diverse from traditional sea-fishing to sea-farming, ship-dismantling, sea-mining, tourism and entertainment, salt industry, construction projects (ports and shipbuilding) and public welfare. Challenges happen when marine use changes from sole use to multiple uses, especially different uses in different sea depths (LI Yanping et al., 2020). In the processes of multiple purpose marine uses and multi-layer developments, the phenomenon of overlapping sea use had occurred from time to time, and the conflicts of marine use rights often happened. For example, construction projects such as undersea tunnels, cross-sea bridges, and offshore oil explorations need cross sea areas used by sea-farming and sea-fishing, which result in inconsistent marine use in the same sea area. Also nuclear power drainage areas often intersect with the sea areas for cross-sea bridges when dealing with RRRs (rights, responsibilities and restrictions) of the near-shore sea area. To meet the requirements China has enacted and enforced several regulations to manage and register 3D marine cadaster.

FIG 3D Cadaster Workshop focus more attentions on land and Land Administration Domain Model has been developed to support the 3D land cadastre; only five papers mentioned 3D marine cadaster. The management of marine rights, restrictions and responsibilities according to international standards was discussed by (Katerina et al., 2016) comparing the traditional cadastral parcel applicable in a marine zone defined by United Nations Convention on Law of the Sea. Michael et al. (2016) and Nor Ainn Alfatihah et al. (2021) offered an answer to the question “How applicable is LADM to marine cadastres?” International Standard Organization and FIG have observed the importance of marine space, and ISO 19152 Land Administration Domain Model didn’t consider the marine domain. But now ISO is revising the content of LADM, in LADM edition 2 a new part, marine space geo-regulation, is added to describe the RRRs for marine space aligning with land concept to provide seamless cadaster from the land into the sea.

Traditional 2D marine management treat the marine parcel as a full sole space from sea surface to bottom sea subsoil, which couldn't reflect the vertical identification about the marine space and couldn't distinguish the different 3D space of sea surface, sea water, seabed and subsoil with different depths/elevations. So, without the 3D space description and 3D in sea areas, it couldn't facilitate the 3D marine developments and utilizations. So it is necessary to explore 3D marine cadaster and specify the 3D use rights with different depth layer. 3D marine cadaster

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can clarify the 3D sea boundaries of marine use right to promote the precise 3D developments and enhance the spatial utilization efficiency.

2. REGULATIONS AND UTILIZATIONS FOR 3D MARINE CADASTRE IN CHINA

2.1 Regulations in China

To promote the developments of marine resources and sea areas, many regulations have enforced to give clear definitions in sea fields. The Law of the People's Republic of China on the Administration of the Use of Sea Areas, which came into effect on January 1, 2002, stipulates that marine areas refer to internal waters, water surfaces, water bodies, seabeds and subsoils of territorial seas, which are owned by the state. It can be seen that the state is the owner of the marine area and has the right to occupy, use, benefit and dispose of the sea area. Therefore, it is within the scope of rights for the state owner to transfer any part of the water surface, water body, seabed and subsoil of the marine areas to others for use. Sea area ownership is the premise of sea area use right, and sea area use right originates from sea area ownership. After the holder of sea area use right has obtained the right to use the sea area according to law, the right to continuously and exclusively possess, use and benefit from certain granted sea area and within a certain period of time. Therefore, from the perspective of the state ownership of marine areas, it is feasible to establish three-dimensional and multiple layer rights for the use of marine areas.

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2.2 Multiple layers of 3D marine space

Marine space is a natural 3D space, and it can be divided by its natural geographical characters that include above the sea surface, sea surface, sea water body, the seabed and the subsoil, which is a three-dimensional vertical space from top to bottom.

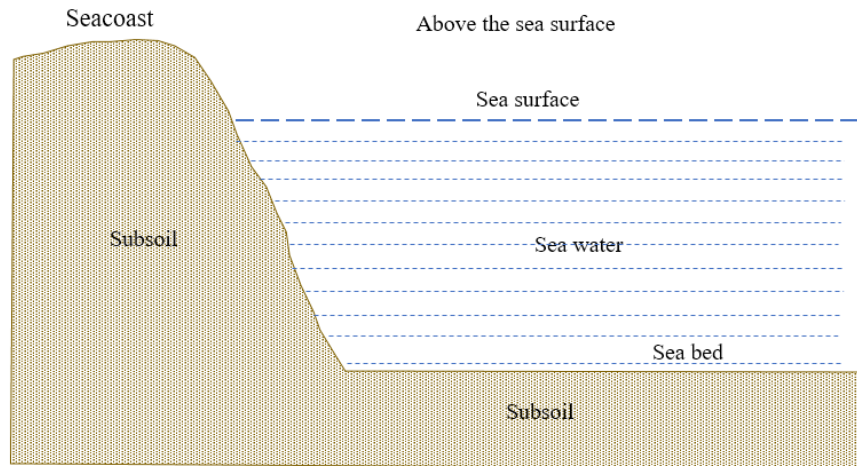


Figure 1. Multiple layers of 3D marine space

Also the marine resources have obvious 3D spatial distribution. For example, Sea-farming, sea-fishing and sea food and other biological resources are generally distributed in the layer of water body, and marine chemical resources are also existed in this layer. The sea water body itself can generate dynamic energies such as tidal energy, wave energy and ocean current energy. Marine mineral resources including the gas and the oil are usually distributed in the layers of the seabed and the subsoil. These different marine resources attract the stakeholders to apply and obtain the ownership/useship right to benefit from the marine space. So correct and precise 3D presentations of 3D marine cadastre become their premise.

2.3 3D marine cadastre with multiple layer use right

In this paper, we develop the 3D marine cadastre by multiple layer rights, and the definition and determination of the marine layer rights integrate the natural three-dimensional stratification of the sea area with different functional purposes of use activities

The use right approval of 3D marine layers means that the holder of the use can exclusively use a specific sea area within a certain period of time, and enjoy the right to occupy, use, benefit and dispose of this 3D marine space. The use rights of 3D marine layers include the use-right of the sea air space use-right (above the sea surface), the sea surface use-right, sea water use-right, seabed use-right, subsoil use-right and comprehensive use-right.

The approval of comprehensive use right is due to the fact that some complex sea-use activities may involve one or several spatial layers of the sea area, and it is necessary to set comprehensive use right according to the specific content of sea-use activities. That is to say, the right object of the use right about the marine area is the specific 3D space, and it is not limited to a certain spatial layer. For example 3D space of the over-sea bridge involve the sea subsoil, the seabed, water body and the space above the sea water level.

In terms of spatial representation, the space of the use right of 3D marine space is represented by 3D geometric space with 3D coordinates by latitude and longitude.

3. CASE STUDY

3.1 Zhuhai Tunnel and Zhuhai Bridge anti-collision construction projects

The Zhuhai Bridge (Figure 2) is located in Zhuhai City, Guangdong Province, China, connecting Zhuhai urban area with Gaolangangdao. Due to the large number of ships passing through the bridge holes, in order to eliminate the possibility of ship hitting with the bridge piers, anti-collision facilities are adopted for the bridge piers. Almost at the same location, another important project, the Zhuhai Tunnel, passes through the sea subsoil. From the birdview planar map the space of Zhuhai Tunnel Project overlaps with that of the Zhuhai Bridge Anti-collision Construction Project (Figure 3). The overlay areas happens not only at the main bridge holes that are used as seaway for sea sailing, but also at the detail piers (Figure 3). With 2D plannar description there is conflicts between them, and couldn't clearly reflect the spatial position relationship and spatial ownership scope of the sea used by the Zhuhai Tunnel Project and the Zhuhai Bridge Anti-collision Construction Project. Therefore, it is necessary to explore the multiple layer useright establishment of marine space to clarify the situation of sea use.

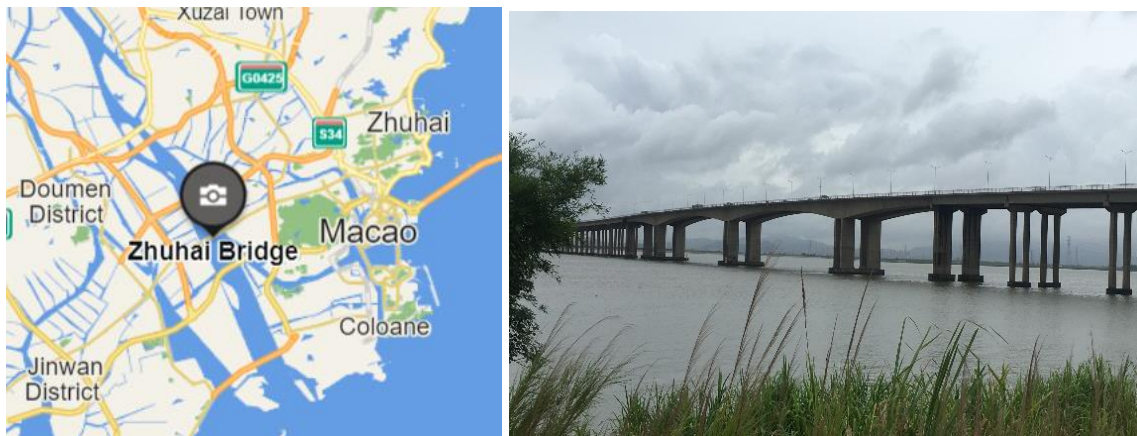
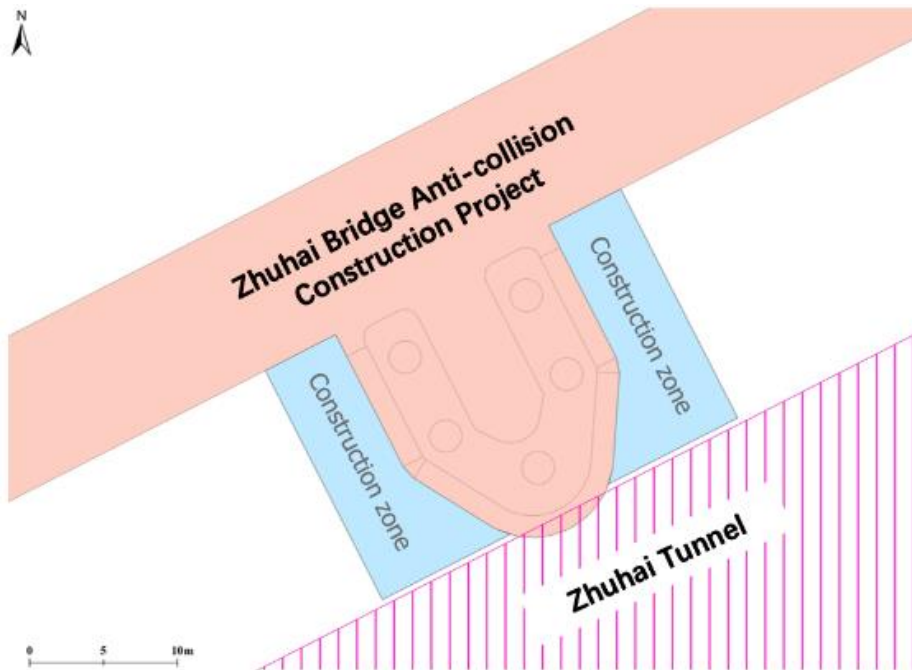


Figure 2. Location of Zhuhai Bridge and realistic view



A



B

Figure 3. Overlay use of multiple marine parcels with Zhuhai Tunnel and Zhuhai Bridge anti-collision construction project: A) overlay areas in planar view; B) the detail overlay

If we analyze this situation from 3D perspective, it would be very clear about the multiple marine uses and useright distribution. Judging from the cross-section diagram of the marine parcel boundaries about the Zhuhai Tunnel and Zhuhai Bridge anti-collision construction

project, the Zhuhai Tunnel is located in the subsoil layer of the sea, and the Zhuhai Bridge anti-collision construction project occupy the space above the water surface, the water surface, the water body, the seabed and the subsoil layers. Clearly, there is no use right conflict between them in the subsoil layer, that is, the Zhuhai Tunnel and Zhuhai Bridge anti-collision construction projects do not overlay in the vertical space of 3D marine space (Figure 4).

With the 3D marine parcel descriptions, Zhuhai Tunnel and Zhuhai Bridge anti-collision construction projects can be handled with consistent spatial locationship. The use right of Zhuhai Bridge anti-collision construction project is a comprehensive marine use that spatially include multiple marine layers: the space above the water surface, the water surface, the water body, the seabed and the subsoil layer. While for Zhuhai Tunnel, only the sea subsoil layer is invovled during its use right approval, and it doesn't intersect or overlay with Zhuhai Bridge anti-collision construction project.

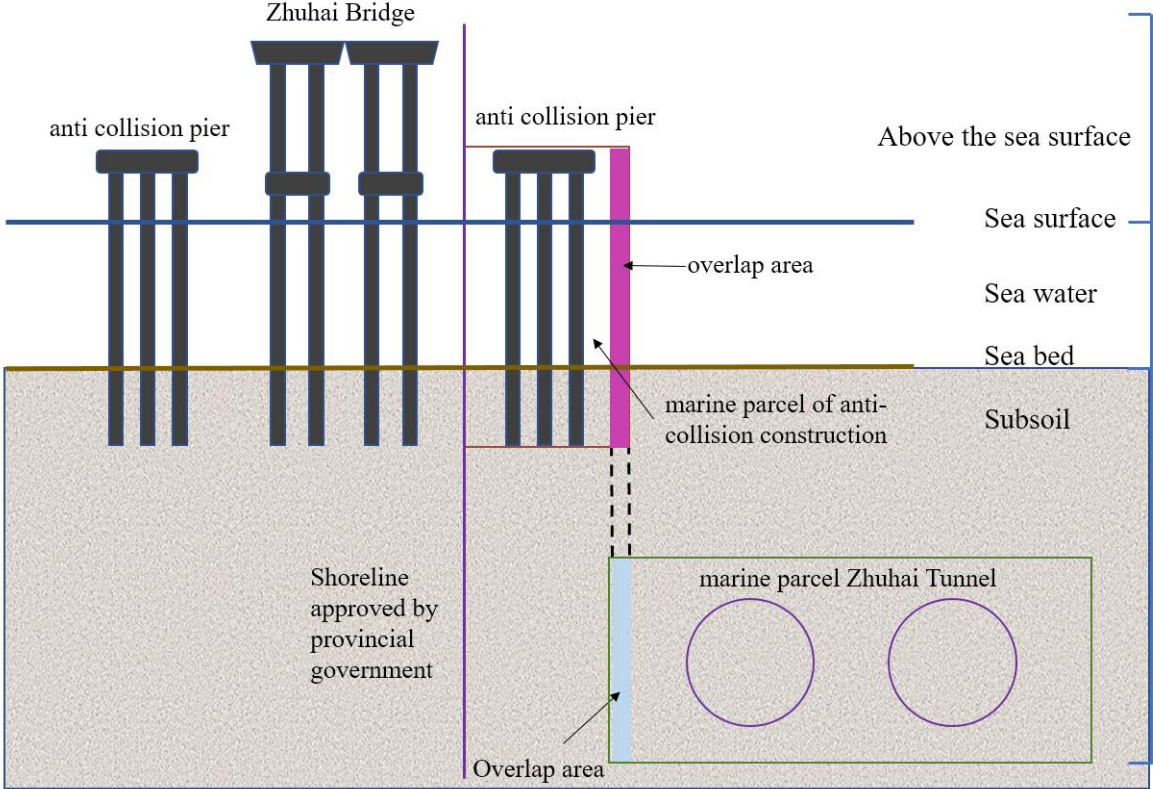


Figure 4. Cross section of Zhuhai Tunnel and Zhuhai Bridge anti-collision construction project

3.2 Shenzhen Bay Port

Hong Kong-Shenzhen Western Corridor is a brige connecting Shenzhen and Hong Kong. Shenzhen and Hong Kong government negotiated to build Hong Kong-Shenzhen Western Corridor to promote the mutual transportation between Hong Kong and Shenzhen and the Mainland. Because of the different jurisdictions between Hong Kong and China mainland, a

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special 3D zone was built with precise 3D geographic description according the physical bridge and legal space (Figure 5), the details in (Guo Renzhong et la., 2011). This 3D space is a pure 3D space over sea surface that contained the physical bridge body (not the piers), from the bottom of the bridge body to 60m and 160m elevation with bridge width. This case illustrates the space over the sea surface is also can be divided for different use right, and it well deal with the 3D spatial administration under multiple juridical systems with different RRRs.



Figure 5. Shenzhen Bay Port above the sea surface

CONCLUSION

Two-dimensional marine space management cannot meet the needs of 3D multiple use of sea areas, and the this paper studies the necessity of setting up 3D marine use rights in layers to tailor the 3D development of 3D marine space. The paper discusses the different uses in sea areas that many locate at different layers, and deliver the layer use right in 3D marine cadastre to support the precise 3D marine parcel representation. Through two real cases, the paper illustrates the approval of 3D marine parcels can clear describe the corresponding 3D space without any conflict that protect the stakeholder's interests and RRRs and enhance the efficiency of marine developments.

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