8 COLLISION WITH A SHIP AT ANCHOR

The first thought is that the contact between a sailing ship and a ship at anchor is a collision that can be modelled by the encounter model. But this is not the most suitable model, because the ship at anchor cannot play an active role in avoiding the collision. A ship at anchor is more like an object as an offshore platform that can be struck by another ship, after a navigational error (ramming) or engine failure (drifting). For this reason the contact drift model (Chapter 6) and the contact ram model (Chapter 7) will be applied to quantify the probability of this type of incident.

A difference is that an offshore platform is a fixed object while a ship at anchor is a temporary object. For this reason a pre-processor is used to generate the input files.

Further, there is a difference when quantifying the consequences. In the other models the consequences are given for the ship being involved in the incident. However, in case a ship at anchor is struck, the damage of the colliding ship will be restricted to structural damage in the bow of the ship in front of the collision bulkhead while the damage of the ship at anchor can be severe. In case of a ramming in the side a cargo tank can be penetrated.

These two differences were the main reasons why a separate model is developed to describe the collision risk for a ship at anchor.

8.1 The pre-processor for an anchorage area

Ships in an anchorage area are waiting to get port entry admission or awaiting orders. For the major ports, dedicated anchorage areas are created and indicated on the nautical charts. However, a ship can also anchor outside the anchorage area, for example when she gets an engine failure, but the probability is much lower than in an anchorage area.

The input for the drift and ram model is a file with a description of all objects as offshore platforms and stranding lines. Such input files are generated from the description of the anchorage areas, being:

- The geographical coordinates of the corners of the anchorage area;
- The average number of ships in the anchorage area;
- The average size of the ships in the area.

These items are described in the input file ANCHORAG.DEF.

One point (G, gravity) in Figure 8-1 can be defined inside the anchorage area. In case this point is not defined (latitude < 1), the point is assigned to the average latitude and longitude of the corner points of the anchorage area.
In the point of gravity G and all corner points (1, 2, ..5) an object with the dimensions of the average ship is defined with a random orientation. The drifting and ramming risk is calculated for these points. The total risk is achieved by summarizing the risk of these points provided with a weight factor. The weight factor is put at the end of the input file and is calculated from the positions of the corner points and the point of gravity. The weighting is based on the surface of the triangle area spanned by two subsequent corner points and G.

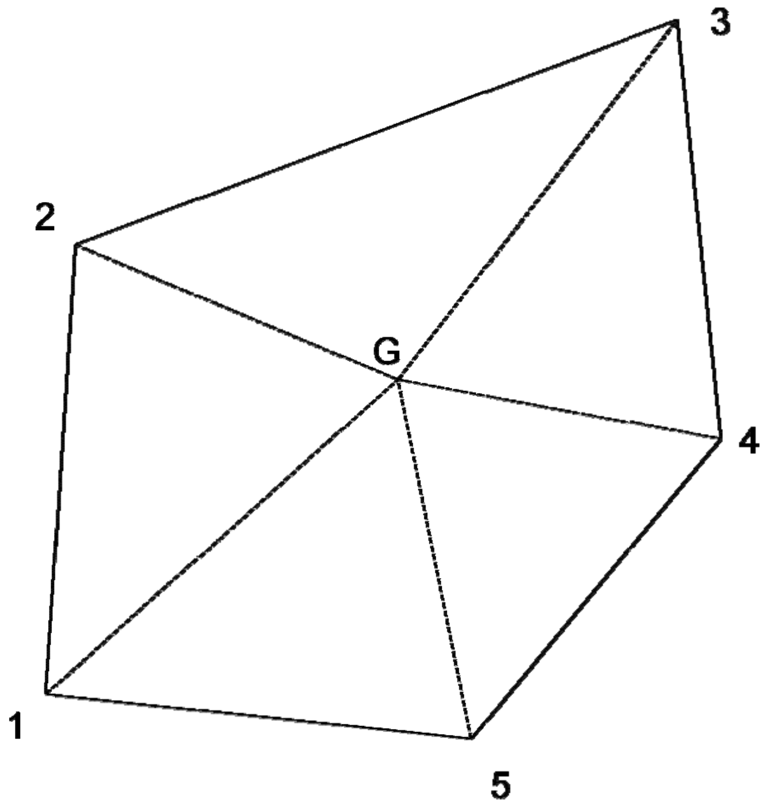

Figure 8-1 Anchorage area defined by 5 points

The weightings are:

G	(1/3) average_ships_at_anchor
1	((Surface ∆12G + Surface ∆51G)/3 / Surface area 123451) x average_ships_at_anchor
2	((Surface ∆23G + Surface ∆12G)/3 / Surface area 123451) x average_ships_at_anchor
3	((Surface ∆34G + Surface ∆23G)/3 / Surface area 123451) x average_ships_at_anchor
4	((Surface ∆45G + Surface ∆34G)/3 / Surface area 123451) x average_ships_at_anchor
5	((Surface ∆51G + Surface ∆45G)/3 / Surface area 123451) x average_ships_at_anchor

The ship at anchor is modelled as an object. It is assumed that this object can be everywhere in the anchorage area, thus randomly divided over the anchorage area. The ship turns around the anchor due to current and wind. This means that all directions are possible for the object (ship). This is indicated in the input file generated by the program CREANK from the anchorage area. CREANK is called the first time a new file with anchorages areas is applied.

Be aware that the corners of the anchorage area have to be defined clockwise. It is possible that the contribution of some triangles is negative in case of abnormal figures. It also happens when the point of gravity is defined by the user on a location outside the anchorage area. It is allowed but not useful because the probabilities inside the anchorage area are more representative.

During the VONOVI analyses [16] it was observed that many ships anchor outside the official anchorage area. This practise is modelled by defining two anchorage areas, one that corresponds with the official anchorage area (solid line in Figure 8-2) and one in which the anchorage area is enlarged (dotted line) with the part that is also used by ships.

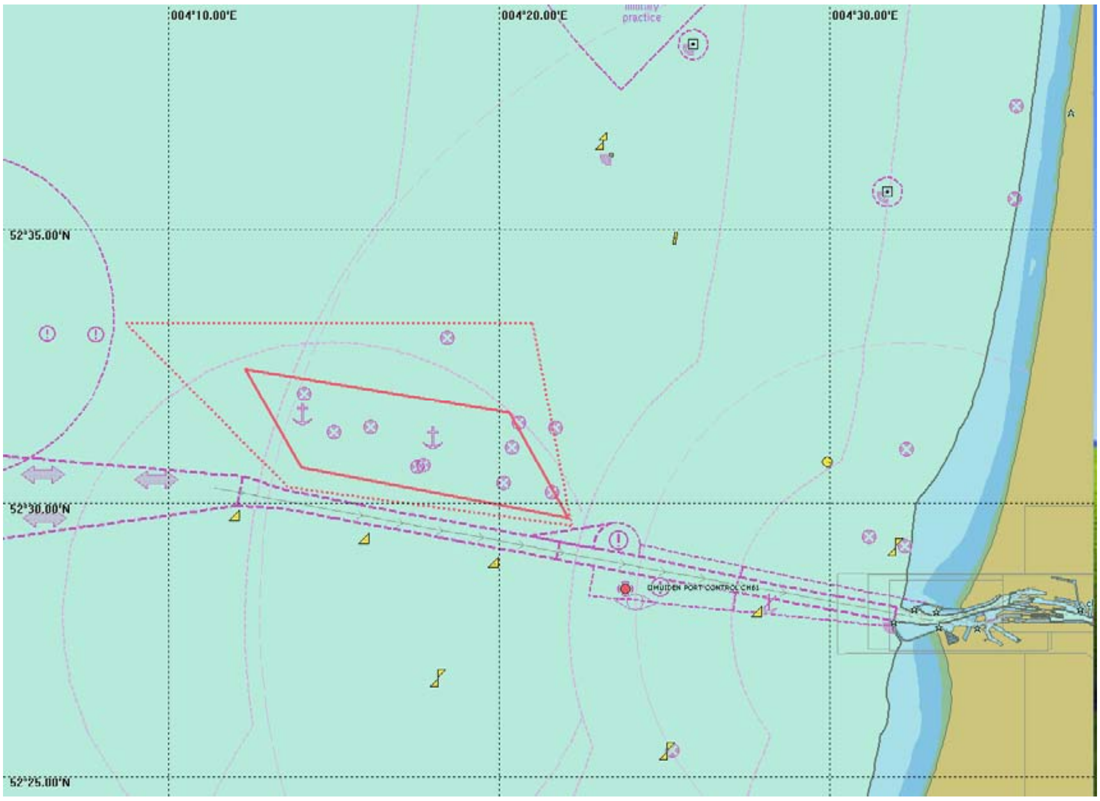

Figure 8-2 The anchorage area off IJmuiden with an enlarged area

The average number of ships for is given for both areas. The average density is the average number of ships divided by the surface. Be aware that the average density for the common area, thus the official anchorage area, is the sum of both densities.

For most applications the approach as followed here is sufficient. However, in cases where for example the location of the anchorage area is subject of the study, the area can be described with more detail. It is possible to cut the area into a number of subareas. In this case the result will be more accurate, because it will be based on a larger spread of possible objects. It is also possible to define for each subarea another average ship or to define the same anchorage area twice for two completely different ships. Thus the tool is flexible to model the user's requirements.

8.2 Contact model

A ship at anchor is considered an object at sea. The ship is exposed to the same type of incidents as another object at sea, as for example an offshore platform. The ship at anchor can be contacted by a drifting or ramming ship.

The same models are used for the calculation of the probability that the object (ship at anchor) is struck by a ramming or drifting ship. Only at the end, when the probabilities are determined, the output written to the intermediate databases are different. This is because it is most likely that an outflow can occur from the collided ship and not from the colliding ship. This is described in more detail in the user documentation, where the output is described.