Ferry wake risk in shallow-water dive operations

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Abstract

Modern fast ferries produce energetic, long-period waves when travelling at high speed in relatively shallow waters. These waves pose potential risk for divers operating in shallow near-shore areas. While ferry wake-induced problems for coastal ecosystems have been widely studied and regulations have been put in place, the subject has been largely missed in occupational diving discussion. This technical briefing presents the background information on the issue and discusses risks related to diving operations. Basic precautions are suggested to avoid incidents while diving in the vicinity of ferry routes.

Keywords: ferry wake, occupational diving, safety, fast ferries, critical speed

1. Introduction

The magnitude of ferry traffic has increased significantly during the last decades, and modern shipping technology has provided companies faster and larger ferries with a length of about 200m and cruising speed up to 30 knots (Kurennoy et al., 2009). Ferries with substantial engine power and speed can generate long-period waves that differ from short and steep waves of conventional vessels.

The type of ferry wake discussed here is produced by vessels travelling at near-critical speeds of depth Froude number ~1. The depth Froude number is the ratio of ship speed to the maximum wave speed in a particular depth of water. The drag of seabed affects the properties of waves when a vessel reaches near-critical speed. This results in tsunami-like waves where energy is concentrated on single long waves (Whittaker et al., 2001; Soomere, 2006). These long-period waves are considered a major contributor to wave impact in some coastal areas (Soomere, 2005) and they pose serious risks for beach users and small crafts (Kirkegaard et al., 1998).

Very long and gently sloping ferry waves are practically invisible in open water zones and can reach shallow water without warning (Whittaker et al., 2001). As the wake reaches the shoreline, waves build in height rapidly and break violently (see Fig 1; Kirkegaard et al., 1998). According to Soomere, at least four fatal incidents have been reported in the Tallinn Bay, the Baltic Sea, as being related to unexpected shoaling and breaking of ferry-induced waves (pers. comm., 2013). There has also been a recent near-critical hit by a vessel wave near Helsinki, reported in Saavalainen (2010). For relevant physics details see Soomere (2006).

Numerous studies have been conducted to evaluate effects of ship traffic on coastal ecosystems (e.g. Lindholm et al., 2001), and wave formation regulations have been established in many countries (e.g. Varyani, 2006). However, issues considering diving safety in areas prone to ferry wake are largely being neglected both in occupational diving education and public discussion. For divers operating in very shallow water (<3m), vessel waves can pose serious risk of injury or loss of equipment. In order to comply with ferry wake issues some precautions are proposed.

2. Ferry wakes and diving operations

Underwater construction and maintenance projects are diverse in coastal areas owing to demand for improvements in shore infrastructure and more effective sea trade. Environmental legislation, e.g. EU Marine Strategy Framework Directive (Directive 2008/56/EC), obligates governments and companies (via e.g. environmental impact assessments) to conduct ecological monitoring in marine areas. Commercial and scientific diving operations are constantly underway close to shipping routes in the vicinity of port cities. In the Gulf of Finland, fast ferries arrive and leave the city of Helsinki about once per hour. These ferries are known to pose hazard to small boats by wake formation.

Divers working in shallow water can get washed ashore by the energy of a sudden wave. This can lead to personal injury on rocky shores or substantial damage to equipment. Wake can also push

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Fig 1: Ferry wash builds in height as it reaches shallow water, and water depth is 1.5m (picture courtesy of Juha Syväranta)

the diver away from the study site, resulting in significant time loss.

Another problem posed by unexpected wave action in shallow water is a potential loss of tools or sampling equipment. Because of stress caused by heavy wave action, loss of gear may remain unnoticed by a diver until he/she is back to the surface, therefore making any recovery of the detached tools impossible. Reduced visibility caused by re-suspended sediment (Erm et al., 2011) will also make retrieving lost equipment more difficult. In addition, strong water movement can cause sampling gear to get tangled to diving gear, transect line or umbilical system.

Scientific divers prefer large writing slates attached around their wrist via surgical tubing. Sample containers, pincers, pens and other gear are usually attached the same way. Large tools act as underwater kites and get pulled by waves, eventually dragging the divers.

Anchoring a small craft near the shoreline can result in the risk for the boat to capsize by the vessel's wake. This poses potential danger to human life and capsizing of a boat inevitably leads to termination of dive operations. Even when the passing fast vessel is seen by boat crew and heard by the diver, it is often impossible to predict the precise arrival time and strength of incoming waves.

Potentially dangerous wash effect is not limited only to areas close to vessel routes, owing to low decay rate of the wake (Whittaker et al., 2001). Ferry wake is known to have erosion effect on shores 7km away from their origin (Parnell et al., 2007). Quality and force of the wake is affected by bathymetry and shore topography (Torsvik and Soomere, 2009). As a wave moves towards shore and water gets appreciably shallower, the wave shoals up and can easily quadruple its height when reaching the shore (Soomere, 2006).

3. Precautions to consider

Diver crews should consult ferry routes and timetables to plan dives accordingly. However, for most active ferry routes it is not always possible to stay within the timeframe between two vessel passings. Surface crew should therefore detect dangerous incoming waves early enough. This can be achieved by watching over for the surf on the shallows closer to ships route, which will experience the waves first.

If underwater telecommunication systems are available, boat crew can inform the diver to exit the water or seek deeper water for safety. In diving operations without voice communication, special rope signals can be used for warning. If a diver is caught by surprise, it is advised to remain near the bottom to avert being moved by the wave.

To avoid equipment being lost, all gear should be attached to D-rings using bolt snaps or other systems that provide secure attachment. Working boats should be anchored to water deep enough to prevent being caught in high waves. Surface supplied diving should only be conducted in times between ferries passing owing to restricted capability to exit quickly. Should the diver get washed against rocks, surface crew must act immediately but carefully in order to avoid more accidents during aggressive wave situation.

4. Conclusion

Ferry wake can be considered as a potential risk factor for professional divers in areas of ferry traffic. Dive crews should therefore consult timetables of ferries to avoid dangerous situations. If incoming wake cannot be escaped, divers are advised not to surface, but to seek a stable position as close as possible to the sea floor to avoid being hit against the ground.

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