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Condor Liberation Safety, Suitability and Performance

Independent Report





🖶 HOULDER

Prepared for States of Guernsey and Jersey

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APPENDIX 1 - AUSTAL VESSEL DATA SHEET

APPENDIX 2 - TERMS OF REFERENCE LETTER

OVERVIEW

Houlder have reviewed the performance of the Condor Liberation against the Terms of Reference agreed between the States of Guernsey & Jersey and Condor.

1. Safety

- a. **Stability** Houlder has no concerns with the stability of the Condor Liberation. The weather used in the stability assessment is appropriate for operation in the English Channel
- b. **Structure** The Condor Liberation is well built. The lightweight structure is necessary to achieve the required performance. Ongoing structural maintenance is typical on high speed craft.

2. Suitability

- a. **Comfort** The levels of passenger comfort in poor weather make Condor Liberation well suited to operating in the English Channel.
- Infrastructure The Condor Liberation can fit into all required ports. The ports would benefit from some customisation for the Condor Liberation.

3. Performance

- a. Reliability Some teething problems are expected with any new vessel, these issues are affecting punctuality. There have only been 3 days when the vessel has not sailed due to engine issues.
- b. Punctuality and Speed The Condor Liberation is able to make good speed in adverse weather whist maintaining passenger comfort. The timetable does not have slack periods and is under review for the upcoming season to investigate options for improving the timeliness of the service.
- c. Ride Comfort In larger waves, when the motions of the previous catamarans would be very uncomfortable the motions of the Condor Liberation are still very well controlled and comfortable, with little noise from the weather or engines in the passenger cabin. In these conditions she has been known to occasionally roll to larger angles. These motions may occur with little warning for passengers and as a result the passengers find these occasional larger roll motions disconcerting. These motions do not present a risk to the vessel due to the large reserve stability.

Condor have updated their procedures for communication to improve passenger awareness of vessel motions and are investigating options for weather routing to avoid the conditions when these motions have occurred in the past.

1. EXECUTIVE SUMMARY

Houlder Ltd has been asked by the States of Guernsey and Jersey to undertake an independent assessment of the safety, suitability and performance of the Condor Liberation for the cross channel service.

Houlder is a UK employee owned business providing a high quality engineering capability within the marine environment. Houlder has been involved in a wide variety of high speed craft projects.

1.1 Background

At the end of March 2015, Condor Liberation joined the fleet of Condor Ferries, operating between the Channel Islands and the UK. A successful pre-launch publicity campaign led to high expectations, however, public confidence in Condor Liberation has been negatively impacted by a number of issues following her introduction into service.

As a result, the States of Guernsey and Jersey agreed with Condor Ferries that an Independent Report be commissioned into the safety, suitability and performance of the Condor Liberation.

The aim of the Independent Report is to provide objective, independent analysis of the ship's safety, suitability and performance, based on clear and credible evidence.

The report covers three key aspects:

1. Safety -

- a. Verification of the vessel's stability
- b. Verification of the vessel's structural characteristics
- 2. Suitability based on the existing infrastructure and the likely sea conditions in the English Channel
- 3. Performance the reliability, punctuality, speed and ride comfort of the vessel.

1.2 Methodology

Houlder has sought to conduct an Independent in-depth review based on available information and time spent on board.

All statutory stability documentation was reviewed.

A range of other information was also reviewed¹. This included information provided by;

- Austal
- Condor
- Other third parties including but not limited to Marine Traffic, Digimap, and published research reports

The Houlder team spent time on board surveying and travelling on the vessel on the 16th July and 24th August 2015. During these journeys, a number of matters were assessed including

- Berthing arrangements
- Seakeeping in a range of sea conditions
- Ride comfort in a range of sea conditions

The ride comfort was further investigated through a study of vessel telemetry for a sample of days with higher winds and larger waves.

The arrival and departure times and also the average transit speed have been assessed using reported vessel GPS data correlated against the Condor punctuality log.

1.3 Introduction

The Condor Liberation is a Trimaran, the trimaran is part of a wider group of vessels called stabilised monohulls. The stability of a trimaran is different to that of a catamaran or monohull. A long slender centre hull is given stability by the amah hulls (Smaller side hulls). Due to the different arrangement the motions of the vessel are also different and may appear unfamiliar.

Condor originally operated Hydrofoils and then more recently catamarans as high speed craft. The Condor Liberation replaced both the Condor Express and Vitesse, which had been operating since 1996 and 1997 respectively. Condor also operates Condor Rapide operating a high speed service between the Channel Islands and France and the Commodore Clipper and Goodwill, these are larger conventional monohull vessels providing a freight service as well as, in the case of the Commodore Clipper, passenger access to the islands.

2 STABILITY

The Stability of the Condor Liberation has been assessed against the requirement of the 2000 High Speed Craft Code (2008 Edition). This covers the safety aspects of the design and operation of high speed craft.

¹ This Report is provided solely to Condor Ltd and the States of Jersey & Guernsey. No reliance can be placed on it by any third parties.

While every effort has been made to ensure the veracity of this information Houlder takes no responsibility for the accuracy of information provided to us for the purposes of this study.

Houlder has undertaken a review of the statutory stability documentation to confirm whether the vessel is stable and suitable for operating in the English Channel. The stability assessment uses a significant wave height of 5m and a wind speed of 50 knots for the worst intended operating condition.

The Condor Liberation has an open car deck. This arrangement provides natural ventilation to the vehicle deck. The vehicle decks have freeing ports (openings) to ensure, in extreme conditions, should water accumulate on the vehicle decks it can drain away as necessary. These openings have been fitted with flaps on them to limit any water entering the vehicle deck through these openings to a minimum, whilst retaining the ability to allow water to flow directly off the deck.

Conclusions

- 1. Houlder can confirm that we have no concerns with the stability of the Condor Liberation, the vessel has been found to comply with the requirements of the International Code of Safety for High Speed Craft, 2000 (2008 Edition).
- 2. The worst intended weather conditions used in the stability assessment are considered appropriate for a vessel operating in the English Channel.

3 SEAKEEPING

The key advantage of a trimaran hull configuration is the seakeeping, the ability of the vessel to be comfortable when operating in waves. The Condor Liberation has a very effective ride control system comprising of active TFoils able to generate large forces to damp the motions of the vessel.

Analysis of vessel telemetry has shown that the ride control system is able to effectively damp the motions of the vessel without the need for the vessel to reduce speed in a seaway in conditions with waves at the upper end of the permit to operate the vessel is comfortable with only limited rolling and pitching. These factors combined with the lack of noise in the passenger spaces give little indication that the Condor Liberation is making over 30 knots in adverse weather conditions.

The seakeeping assessment reviews general vessel motions as well as focusing on larger roll motions. Within the context of this assessment a larger roll motion is considered to be larger than 11.5° away from horizontal.

On the 24th August 2015 Houlder attended the vessel for a round trip to better understand the vessel's motions in a seaway in adverse weather conditions. On the return leg of the trip from Guernsey back to Poole, around the Banc de la Schôle, the wind was over 30 knots from the west, this opposed the tide of about 1 knot. The wind against tide conditions led to very short breaking waves directly on the beam, with a wavelength similar to the beam of the vessel. During this part of the crossing the vessel rolled to more than 11.5^o on 4

occasions, with a maximum roll angle recorded at 15.5°. A roll of this angle does not present a risk to the vessel due to the large reserve stability

Additional telemetry data for the Condor Liberation was requested for the days known to have poor weather conditions. The vessel is known to have exceeded a heel angle of 11.5° on 4 separate days. These motions occurred on at least 3 different legs of the route and with various combinations of wind and tide.

It is noted that on the 5th July, when the waves were reported to be at the limit of the permit to operate, the maximum vessels roll was only 7.3°. This is less than the maximum roll of 8.2° that occurred on the 15th September when the wind and wave conditions were comparatively benign.

As a Trimaran the performance and motions of the Condor Liberation are different to either high speed catamarans or conventional ferries. The Condor Liberation provides a cosseted environment for the passengers. While there is some shuddering as waves slap on the hull, in the most part the vessels motions are small and gentle, with little noise from the vessel or the weather outside, even when operating in high winds and larger seas.

Conclusions

- The ability of the Condor Liberation to maintain average speeds over 30 knots in sea-states with a significant wave height over 3m is exceptional. Given the conditions experienced in the English Channel on a regular basis this capability is advantageous to her operation.
- 2. In larger sea states, not directly on the bow or stern, when the motions of the previous catamarans would become very uncomfortable the motions of the Condor Liberation are still very well controlled and comfortable, however she has been shown to occasionally roll to larger angles. These motions may occur with little warning for passengers and as a result the passengers find these occasional larger roll motions disconcerting. The larger roll motions have been known to occur on both the north and southbound legs of the round trip, between the islands, between Guernsey and the Casquets and in mid channel. These motions do not present a risk to the vessel due to the large reserve stability.

Recommendations

- 1. If the Condor Liberation continues to occasionally roll to large angles then it is important that this behaviour is better understood, and this would either require a programme of tank testing or a well-managed period of sea trials.
- 2. When conditions are similar to those that have been known to cause larger rolling motions in the past warnings should be provided to the passengers regarding the potential vessels motions and advising passengers to remain seated. Condor have confirmed this has been implemented and they are

updating their operations manual to include additional communication to passengers.

3. Weather routing should be implemented to reduce the likelihood of large roll angles occurring on board. Condor have confirmed they are developing a strategy for weather routing of the Condor Liberation.

4 STRUCTURE

Houlder has undertaken a structural survey in key areas of vessel. This is the most effective way to observe the ability of the arrangement of the structure to withstand the loads on it in service.

The structure of the Condor Liberation is similar to other high speed craft. The main central hull is linked through cross decks to two buoyant side hulls known as amah hulls. The amah hulls provide stability to the main hull. The entire structure is fabricated from marine grade aluminium alloy.

On Saturday 28th 2015, Condor Liberation suffered minor damage to the port amah, having landed against a single vertical steel cylindrical piling. The damaged area has been repaired to the satisfaction of the DNVGL surveyor.

Additionally on both the Port and Starboard Sides, the wet decks between the bulkheads at frames 48 and frame 56 have also been damaged. The damage comprises of the wet deck plating being set upwards causing plate buckling of the floor structure overall, the deformation is most evident in way of the connection to the wet deck plating. A temporary repair has been effected in these areas to the satisfaction of the DNVGL surveyor. Permanent repairs will be made during the next scheduled docking of the vessel. The areas forward and aft of this show no further damage of a similar nature.

Conclusions

- 1. The Condor Liberation has been built to a high standard. Her style of structural arrangement is necessary for the vessel to achieve the required transit speed and deadweight capacity.
- 2. The damage sustained to date is not uncommon on high speed craft. A programme of temporary repairs has been implemented to enable effective permanent repairs to be made at a scheduled dry docking. An ongoing programme of structural maintenance on high speed light craft is not uncommon to maintain the lightweight structure as was undertaken on the previous Condor Catamarans.
- 3. All repairs, to date, have been carried out to the satisfaction of attending DNV GL surveyors.

Recommendations

1. Condor should continue to undertake regular weekly inspections of the areas of wetdeck damage outboard of the workshop between frames 48 and 56 until full permanent repairs have been undertaken and proven to be satisfactory.

5 BERTHING ARRANGEMENTS

Houlder has reviewed the suitability of the vessel to berth in the Channel Ports.

In general high speed craft tend to have dedicated berths with vessel specific infrastructure that can be designed to accommodate a single vessel's requirements. This would include specific fendering which could spread berthing loads over a larger area or be more flexible to reduce impact accelerations and hence the likelihood of damage when berthing. This has not been implemented in Guernsey or Jersey, where the dockside fenders appear to be designed to accommodate much heavier vessels.

Conclusions

- 1. The Condor Liberation appears to demonstrate different berthing capability when compared to the previous Condor catamarans.
- 2. While the seakeeping of the Condor Liberation enables her to operate comfortably in waves towards the upper range of the permit to operate with considerably reduced risks of cargo damage and motion sickness, she does not have an equivalent berthing capability and this may limit her operability at times.

Recommendations

- 1. If the full benefits of the Condor Liberation's seakeeping performance are to be realised, Condor should consider how additional berthing capabilities can be best achieved. A cost / capability study of the options for vessel modification should be considered.
- 2. Options for modification to the shore side fendering be investigated to determine feasibility for increasing the contact area with the Condor Liberation's belting and also to reduce the stiffness of the connection to the Dock side.
- 3. Options for strengthening the Condor Liberation's belting structure be investigated.

6 RELIABILITY

A review of the reliability and Condor's systems to ensure vessel operability has been undertaken. The vessel has a service agreement with MTU to enable the ongoing maintenance of the main engines. The service agreement is contingent on the engines being operated in accordance with an agreed operating profile.

The main engines have some ongoing reliability issues which have affected the vessels punctuality and reliability.

Recommendations

1. Condor should review the operating point used for the main engines to ensure they have, thus far, been operated within the terms of the service agreement.

7 SPEED AND PUNCTUALITY

A log of departure and arrival times from the 28th of March, when the Condor Liberation entered into service to the 17th September has been reviewed. The information provided includes a log of sea state as well as cars and passengers on board. In addition Houlder has obtained AIS speed and position data for the vessel.

The average speed of the vessel when underway since entering into service up to the 17th September was 32.2 knots.

Conclusions

- 1. The speed of the vessel on passage is not significantly affected by either wind strength or wave height. The average speed of the vessel reduces by less than 1.0 knot across the range of sea states available.
- 2. The speed of the vessel reduces as more cars are carried with the vessel being 2 knots slower when heavily laden with more than 150 cars when compared to crossings with less than 100 cars on board.
- There is a keen awareness on board the Condor Liberation of the importance in keeping to the timetable. With this in mind the crew aim to leave port as soon as practicable. In September the vessel left Poole before her scheduled departure time 82% of the time. This has helped in achieving 95% timely arrivals in both Guernsey and Jersey on the outbound legs of the journey.
- 4. The Condor Liberations ability to make good speed while maintaining passenger comfort in higher seas is not well represented by the analysis of punctuality data. Where the previous Condor catamarans may have been heavily delayed due to weather the Condor Liberation is able to maintain a high transit speed without undue passenger discomfort.

Recommendations

1. The timetable should be reviewed for the coming season to investigate options for improving punctuality.

If you require any further information or should anything in this document require clarification, please contact;

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Nomenclature

Amah Hull	The outer hulls on the Trimaran referred to as amah hulls by Austal
HSC 2000	International Code of Safety for High-Speed Craft, 2000 (2008
	Edition)
MTU	The engine and generator manufacture
RCS	Ride Control System - used to dampen the vessels rolling and pitching motions
T-Foil	Underwater Lifting surface, generates lift to dampen the vessel motions and improve passenger comfort
Trimaran	A vessel with three separate hulls

Nomenclature

Amah Hull	The outer hulls on the Trimaran referred to as amah hulls by Austal
Displacement	The weight of a ship equivalent to the weight of water it displaces.
DNVGL	Det Norske Veritas Germanischer Lloyd. The society responsible
	for the Classification and Statutory Certificates for the Condor
	Liberation.
Floor	Deep transverse structure that supports bottom shell or wet deck
	longitudinals, generally formed of vertically stiffened plating
GML	The distance between the VCG and the Longitudinal Metacentre
GMt	The distance between the VCG and the Transverse Metacentre
GZ	The horizontal distance between the TCB and TCG
GZ Area	The area under the GZ curve
HSC	High Speed Craft
HSC 2000	International Code of Safety for High-Speed Craft, 2000 (2008
	Edition)
Interceptor	Movable flat plate positioned on the transom used to change the
•	pitch of the vessel resulting in a reduce power required for a given
	speed.
LCS	Littoral Combat Ship - 127m Trimaran
Longitudinal	Stiffener that supports plating structure, In the case of the Condor
-	Liberation, these are used for supporting the side, bottom shell
	plating and wet deck plating
Main Hull	Central Hull of the Trimaran
MCR	Maximum Continuous Rating - The Maximum power the engine can
	produce on a continuous basis. The engine should be operated at
	an average of 85% of this power under normal circumstances
Monohull	HSC 2000 – Any craft which is not a multihull
MTU	The engine and generator manufacture
Multihull	HSC 2000 - A craft which in any normally achievable operating trim
	or heel angle has a rigid hull structure which penetrates the surface
	of the sea over more than one discrete area
Pitch period	Similar to roll period but for pitching motions.
RCS	Ride Control System - used to dampen the vessels rolling and
	pitching motions
Roll period	The time taken for the vessel to roll from one side to the other and
	back again.
RoPax	Vehicle and passenger ferry
Shell	Plating that forms the surface of the side or bottom surface of the
	hull designed to resist the static and dynamic loads from the from
	the sea
Significant wave	The mean height of the largest 1/3 of waves. This measure is
height (H _{1/3})	closely related to the average wave height estimated by an
	experienced observer.
SWATH	A snip characterised by a "Small Waterplane Area Twin Hull"
ICB	I ransverse Centre of Buoyancy
TCG	Transverse Centre of Gravity

T-Foil	Underwater Lifting surface, generates lift to dampen the vessel motions and improve passenger comfort
Trimaran	A vessel with three separate hulls
US DoD	United States Department of Defence
VCG	Vertical Centre of Gravity
Web Frame	Transverse structure used to support the side shell longitudinals.
	Generally fabricated from plating, configured as a T Section
Wet Deck	Plating that forms the underside of the cross deck connecting the main hull to the amah Hulls

Prepared by Houlder Ltd

References

- 1. International Code for Safety for High-Speed Craft, 2000 (2008 Edition) (HSC 2000)
- 2. 270-100-U00-801R-RevG Final Stability Information Book
- 3. Permit to Operate
- 4. Intact Stability Code
- 5. Condor Liberation Berthing incident Summary Report Guernsey Harbours July 2015
- 6. FINAL Condor Liberation SPP contact 28Mar15 investigation report 29Apr15
- 7. Condor Group Route Operations Manual
- 8. Condor field service report
- 9. Condor MTU Maintenance Agreement
- 10. Condor Liberation Punctuality Report CFR-04 for 28 March 2015 to 17 September 2015
- 11. AIS Data for HSC Condor Liberation MMSI 311037300 28 March 2015 17 September 2015
- 12. 270-170-111 Rev A Sea Trials Record 13 Aug 2014

2. INTRODUCTION

Houlder Ltd (Houlder) was asked by the States of Guernsey and Jersey to produce this Independent Report into the safety and suitability of the Condor Liberation for the cross channel service.

Houlder is a UK employee owned business providing a high quality engineering capability within the marine environment.

The company delivers specialist Consultancy, Design and Engineering, Procurement, Installation and Commissioning from offices in London, Houston, Aberdeen, Portsmouth and Tyneside and its client base takes in the Marine, Oil and Gas and Renewable Energy markets.

Houlder has been involved in a wide variety of high speed craft projects including supervision of the build of the SuperSeaCat monohulls for Sea Containers, technical support to Wightlink for the build of the Wight Ryder vessels, design services for the major refit and modification of the HSC Manannan.

The terms of reference of this Independent Report are detailed in the letter, Appendix 2. This sets out the structure of the investigation and key reporting that is required.

2.1. Background

At the end of March 2015, Condor Liberation joined the fleet of Condor Ferries, operating between the Channel Islands and the UK. A successful pre-launch publicity campaign led to high expectations, however, public confidence in Condor Liberation has been negatively impacted by a number of issues following her introduction into service.

As a result, the States of Guernsey and the States of Jersey agreed with Condor Ferries that an Independent Report be commissioned into the safety, suitability and performance of the Condor Liberation.

The aim of the Independent Report is therefore to provide objective, independent analysis of the ship's safety, suitability and performance, based on clear and credible evidence.

The report covers three key aspects:

- 1. Safety
 - Verification of the vessel's stability
 - Verification of the vessel's structural characteristics
- 2. Suitability based on the existing infrastructure and the likely sea conditions in the English Channel

3. Performance – the reliability, punctuality, speed and ride comfort of the vessel.

2.2. Methodology

This Independent Review has been conducted using Houlder's expertise. A wide range of data sources and time spent on board.

A structural survey was undertaken on 16th July and 26th August 2015.

All statutory stability documentation was reviewed.

A range of other information was also reviewed². This included:

- Information provided by Austal
- Information provided by Condor
- Information provided by other third parties including but not limited to Marine Traffic, Digimap, and published research reports

The Houlder team spent time on board surveying and travelling on the vessel on the 16th July and 24th August 2015. During these journeys, a number of matters were assessed including

- Reviewing berthing arrangements
- Seakeeping in a range of sea conditions
- Ride comfort in a range of sea conditions

The ride comfort was further investigated through a study of vessel telemetry for a sample of days with higher winds and larger waves.

A review of the field service report, arrival and departure times and also the recorded speed on passage (using Condor records from when she entered into service on the 27th March 2015 up to the 17th September 2015).

Conclusions are drawn at the end of each section, based on observations of the facts presented. Recommendations are also made where relevant.

2.3. Notes

Houlder would like to thank Condor and its staff for giving their time freely to assist in the compiling of this report.

All of the Condor crew have at all times been polite, courteous and seen to act with integrity and professionalism.

² While every effort has been made to ensure the veracity of this information Houlder takes no responsibility for the accuracy of information provided to us for the purposes of this study.

Austal have offered their cooperation and assistance in the completing of this report, their input has been important to enable Houlder to better understand some of the complexities of the Condor Liberation.

The conclusions drawn within this report are limited to the issues as set out in the Terms of Reference, the data reviewed and observations from time spent on board the vessel. We would anticipate that Condor will continue to monitor the performance of the vessel in accordance with best industry practice

This Report is provided solely to Condor Ltd and the States of Jersey & Guernsey. No reliance can be placed on it by any third parties.

This Report has been prepared in good faith on the basis of information and data provided to Houlder by Austal Ships Pty Ltd., designers and builders of the Condor Liberation. The information has been provided expressly without any representations or warranties by Austal Ships as to its accuracy, reliability, completeness or suitability for any particular purpose. Therefore Houlder can accept no liability in relation to this Report, its findings and any conclusions drawn, arising from any inaccuracy, incompleteness, unreliability or other error or flaw of or in such information and data.

3. STABILITY ASSESSMENT

3.1. Hull Type

The Condor Liberation is a Trimaran, the trimaran is part of a wider group of vessels called stabilised monohulls, these also include;

- Proa, comprising a large main hull and a single small stabilising hull
- Pentamarans, a large central hull stabilised by 4 small additional hulls

Within this report the Condor Liberation has been referred to as a Trimaran.

The stability of a trimaran is different to that of a catamaran or monohull. A long slender centre hull is given stability by the amah hulls (Smaller side hulls). This configuration enables the naval architect to produce a long slender centre hull, similar in form to that of a catamaran. This is optimised to minimise the power required for the desired vessel speed. This optimum hull form would be unstable without the addition of the Amah hulls. The Naval Architect can design the amah hulls to give sufficient stability for the vessel, but also to optimise the ride comfort.

3.2. Upright Stability - GM

The measure of upright stability is called "GM" this is the distance between the centre of gravity (G) and a point called the metacentre (M), and is illustrated in Figure 1. The metacentre is equivalent to a virtual pivot on a pendulum with the ship beneath it. The Metacentre gives a mathematical description of the upright stability of the vessel relative to its displacement.

Figure 1 gives a graphical illustration of the principles of stability. It can be seen that as the centre of gravity rises the distance GZ will decrease as will GM, this will make the vessel less stable. If the centre of gravity is above the metacentre the vessel will be unstable.

3.3. Large Angle Stability - GZ



Figure 1 Diagram of stability principles

As can be seen illustrated in Figure 1, GZ is the horizontal distance between the centre of buoyancy, the point through which the buoyancy force acts vertically upwards, and the centre of gravity, the point through which the weight of the vessel acts vertically downwards. GZ is the righting lever and a measure of the stability of the vessel. Figure 2 illustrates how GZ varies as various vessels are heeled (i.e. takes up an angle of inclination from the vertical). There are rules that govern the required area under the curve and the location of the peak. There are three key parts to the GZ curve.

- 1. The slope at the origin, this tells us how stable the upright vessel will be, the steeper the angle the more stable the vessel is.
- 2. The height of the peak of the GZ curve, this indicates the ability of the vessel to resist heeling forces, noting than many heeling forces will reduce as the vessel rolls.
- 3. The angle at which GZ becomes zero, this is called the angle of vanishing stability, it can be considered as the point of no return.

Additionally the downflooding angle is also important, the point at which openings in the hull become submerged. Within statutory assessments of stability, none of the residual stability beyond this point is considered, although, in reality the stability of the vessel at this point will then depend on how much water has entered the vessel through the submerged openings. The statutory assessment takes a conservative approach and truncates the GZ curve at this point.



Figure 2 GZ Comparison

The different GZ curves shown in Figure 2 are for a typical high speed monohull, the Condor Express (high speed catamaran), and the Condor Liberation (Trimaran). By comparison the stability curve for the Commodore Clipper, at its maximum passenger carrying draft of 5.6m, is also illustrated. The Commodore Clipper's GZ curve is consistently lower than all the other vessels.

The data for Figure 2 has been taken from the statutory stability information books for the vessels listed.

3.4. Roll Response

The behaviour of the Condor Liberation is different to the high speed catamarans which it has replaced.

The Catamaran is a highly stable platform which exhibits small roll angles, but also with high accelerations caused by the roll motions. This type of vessel motion is known to cause a high degree of motion sickness.

Catamarans have an additional issue with the combined motion and accelerations resulting from both roll and pitch periods being similar. This can lead to a very uncomfortable corkscrewing motions when pitch and roll motions coincide at certain wave incidence.

Due to the high roll stability of the Catamaran it is very difficult to damp the roll motions (accelerations) of the vessel with a ride control system.

By comparison a Trimaran is expected to roll to larger angles than a catamaran. The Catamaran is expected to roll more than the trimaran given the shorter roll period, in a comparable loading condition and sea state, however the accelerations on the Trimaran would be significantly reduced. Due to the longer roll periods of a Trimaran, active roll stabilisation systems can effectively damp the vessels roll motions.

3.5. Conclusions

The stability of the Condor Liberation is different to that of other vessels, and especially in comparison to the catamarans which she replaces. This enables the ride comfort to be improved.

The Condor Liberation is more stable than a comparable high speed monohull, or a conventional ferry like the Commodore Clipper.

4. **STABILITY REVIEW**

4.1. Stability Documentation

Houlder has undertaken a review of the statutory stability documentation to assess whether the vessels is stable and suitable for operating in the English Channel. These documents cover the stability assessment based on the criteria in HSC 2000 (2008 Edition), the International Code for of Safety for High Speed Craft [Ref 1].

The assessment of the stability of any vessel is based on the weight and centre of gravity of the vessel. In the case of the Condor Liberation, and in keeping with all other ferries, an inclining test was carried out to establish the weight and centre of gravity. This test was carried under the supervision of DNV GL – a world renowned Classification Society and considered the expert classification society in high speed craft.

Statutory stability documentation has been produce using agreed loading conditions to verify the stability of the vessel against the criteria in the HSC2000.

Houlder has reviewed the finalised stability information book [Ref 2]. This has been stamped and approved by DNV GL on the 11th May 2015. This document is based on the latest inclining experiment from the 16th March 2015, and includes covers the vessels operation in the worst anticipated weather conditions up to a significant wave height of 5.0m and a wind speed up to 50 knots.

As part of the review of the stability documentation undertaken by Houlder, we have carried cross checking of the assumptions and the mathematical processes of the stability calculations.

The vessel is provided with a certificate of class from DNV GL enabling her to operate up to a significant wave height of 5m, and the stability has been assessed for waves up to this wave height. Her operations are currently limited to waves up to a significant wave height of 3.5m by her permit to operate [Ref 3].

The static stability required by the applicable statutory regulations does not consider the vessel in a seaway but does make allowances for rolling of the vessel due to the action of wind and waves.

4.2. Wave Roll Angle

Within the stability assessment undertaken reference is made to the wave roll angle calculation in the International Maritime Organisation Intact Stability Code (IS code) [Ref 4]. Austal has used an angle of 15°, this value is applicable to vessels with high damping, and examples include vessels with immersed side hulls. This has been agreed with DNV GL.

The IMO weather criteria seek to simulate a situation where the vessel is rolled into the weather by the seas, when she has rolled to a maximum angle a gust will roll her back to beyond the equilibrium heel angle. The assessment provides reassurance that the vessel has sufficient stability when rolling in a seaway.

Houlder has reassessed the stability in the full load departure and arrival cars and trucks conditions to evaluate the maximum wave roll angle that could be used for the vessel to pass the stability. These conditions were chosen as the evaluation of the GZ area up to the down flooding point shows these are expected to be the worst case conditions.

Based on our evaluation of information presented in the latest stability information book the vessel is expected to pass the stability criteria with a wave roll angle of at least 25°.

4.3. Open Car Deck

The Condor Liberation has been designed with an open car deck. This arrangement allows for natural ventilation of the vehicle deck. Some ventilation of the vehicle deck is required to avoid the build-up of fumes from exhausts and because of the fuel carried within the vehicles. Due to the ventilation requirements it is not practical to cover the opening in the bow. This arrangement is common on high speed ferries.

Because of the openings required to achieve the ventilation of the car decks statute requires that freeing ports (large openings), with a minimum total area are located on the upper and lower car decks to prevent the build-up of any water on this deck. The freeing ports have been fitted with flaps on them to limit any water entering the vehicle deck through these openings to a minimum, whilst retaining the ability to allow water to flow directly off the deck..

It is noted the freeing port calculation undertaken by Austal has been verified by DNV GL. Houlder have undertaken an independent check of the actual and required area of the freeing ports and can confirm that they are sufficient based on the statutory requirements.

4.4. Conclusion

Houlder can confirm that we have no concerns with the stability of the Condor Liberation, the vessel has been found to comply with the requirements of the International Code of Safety for High Speed Craft, 2000 (2008 Edition).

The worst intended weather conditions used in the stability assessment are considered appropriate for a vessel operating in the English Channel.

A number of technical questions were raised during our thorough review of the stability documentation and Austal have provided comprehensive answers to these. It should be noted that the vessel stability has been verified by DNV GL and they have approved all the stability documentation on board the vessel,

none of the technical questions raised cast any doubt on the capability of the vessel to comply with all required stability criteria.

The vessel will comply with all necessary stability criteria, as defined by the HSC 2000 with a wave roll angle increased to at least 25° and this is greater than any wave induced roll known to have occurred on the vessel to date.

Prepared by Houlder Ltd

5. SEAKEEPING – SUITABILITY FOR OPERATION IN THE ENGLISH CHANNEL

The seakeeping motions of the Condor Liberation are damped by a ride control system. Without this system operating effectively the vessel motions would be considerably greater and the operability of the vessel would be significantly reduced.

The Condor Liberation ride control system comprises three TFoils. A forward TFoil controls pitching motions of the vessel. Two aft TFoils positioned on the amah hulls control roll motions, and are also utilised to control pitching motions. The TFoils are actively controlled to generate forces damping the vessels motions. The TFoils do not generate lift to support the vessel.

The effective operation of the ride control system is important in achieving the ride comfort expected on a vessel like the Condor Liberation.

The seakeeping assessment reviews general vessel motions as well as focusing on larger roll motions. Within the context of this assessment a larger roll motion is considered to be larger than 11.5° away from horizontal. A static heel angle of 11.5° is equivalent to a lateral acceleration of 0.2g.

5.1. Vessel Motions Assessment

This assessment is based on a crossing attended by Houlder on the 24th August 2015. Houlder attended the vessel for a round trip to better understand the vessels motions in a seaway in adverse weather conditions. This was undertaken following the crossing on the 18th May, when the vessel was estimated to have rolled to approximately 18^o in stern quartering seas.

Following the crossing attended by Houlder, a download of some key vessel telemetry was provided for this day, to enable analysis of behaviour of the vessel. This has enabled Houlder to better understand the behaviour of the vessel observed whilst on board.

During the crossing on the 24th August 2015 the vessel rolled to more than 11.5° on 4 occasions, with a maximum roll angle recorded at 15.5°. This occurred between 16:55 and 17:15 from 49°34.5'N 2°24.6'W to 49°43.9'N, 2°18.3'W, when the vessel passed the Banc de la Schôle, on the track shown in Figure 2. The sea state calmed on passing the Casquets lighthouse. During this time the vessel was manually steered with the master at the helm, the ride control system was active.

High water in Dover was at 1800 GMT on the 24th August 2015, with neap tides, the tidal chart for 1 hour before high water is shown in Figure 5. The wind during this period was around 30 knots from the west. These conditions caused the sea state to increase rapidly to a significant wave height of approximately 3m, with short breaking waves directly on the beam.

At the time the vessel did not reduce speed. Any speed reduction is expected to result in a reduction in the maximum force that can be generated by the ride control system and this may reduce the effectiveness of the ride control system to damp the vessel motions.

The operation of the vessel was in accordance with the permit to operate. The vessel's permit to operate [Ref 4] calls for a reduction in speed to no more than 34 knots in a significant wave height between 3.0m and 3.3m and 31 knots in waves with a significant wave height over 3.3m but less than 3.5m. The limits in the permit to operate were in line with the passage making ability of the vessel at the time and were not limiting the performance of the vessel.

Significant Wave Height (metres)	Maximum Speed (knots)
0-2.9m	40knts
2.9-3.0m	38knts
3.0-3.3m	34knt
3.3-3.5m	31knt
>3.5	Return to port at slow speed

Figure 3 Speed Wave Restrictions from Permit to Operate [Ref 4]

Key observations can be summarised as follows;

- 1. The roll motions observed during the crossing on the 24th of August occurred when the vessel was operating in short steep waves generated by wind against tide conditions that were directly on the beam.
- 2. There is no discernible or common build up to the vessel rolling to a large angle (>11.5°). In this regard the event appears sudden and unexpected to the passengers on board. This causes increased disquiet amongst the passengers on board.
- 3. After the vessel has reached the maximum roll angle, she rolls back to near vertical and does not tend to overshoot or continue to roll harmonically after the initial roll. The roll is asymmetric and has only been observed to have occurred away from the direction of the weather and is an isolated event.
- 4. The vessel maintained her speed as she rolled, dropping about 2 knots. She then accelerates back to her average transit speed.
- 5. The vessel has large reserves of stability. While the motions of the vessel may appear disconcerting to passengers they do not present a risk to the stability of the Condor Liberation.



Figure 4 Track for vessel rolling on the 24 Aug 2015



Figure 5 Tidal Chart

5.2. Analysis of Additional Telemetry Data

Following on from a review of the telemetry data provided for the crossing attended by Houlder on the 24th August, additional vessel telemetry was requested for a number of days on which higher winds and larger waves had

been encountered. A further day was included with comparatively benign weather conditions, this has enabled comparisons to be made.

The data was analysed for motions where the roll angle exceeded 11.5°. The location of these rolling motions was noted. The crossing has been split into 6 legs. These are in both northerly and southerly directions between;

- Poole and the Casquets lighthouse (Mid Channel)
- Casquets lighthouse and Guernsey
- Guernsey and Jersey

From the data provided the vessel is known to have exceeded a roll angle of 11.5° on 9 occasions over 4 separate days. These roll motions occurred on at least 3 different legs of the round trip and with various combinations of wind and tide, in both north and southbound directions.

It is noted that on the 5th of July, when the waves were reported to be at the limit of the permit to operate (3.5m significant wave height), the maximum vessel roll was only 7.3° , and this is less than the maximum roll of 8.2° that occurred on the 15th September when the wind and wave conditions were comparatively benign (0.5 - 1.5m significant wave height).

5.3. Passenger Experience

The vessel is generally quiet and motion well controlled by the ride control systems on board.

Whilst on board the vessel, and when the conditions outside had deteriorated significantly, with winds of around 30 knots and short steep waves of around 3m it was noticeable how controlled the passenger environment was. There was very little noise in the passenger compartment from either the engines or from the weather outside. While there is some shuddering as waves slap on the hull, in the most part the vessels motions are small, gentle and controlled. In this sense the passenger experience on board the Condor Liberation more closely resembles being on a train rather than a conventional ferry or high speed catamaran. This was surprising given the speed of the vessel, the strength of the wind and the sea state.

Given the comfort and consistency of the vessels motions, and the lack of any sense of the weather, the perception of any large vessel motions may be amplified, as they are not anticipated. These occasional larger roll motions are disconcerting as they are not expected and are also unfamiliar.

On the crossing on the 24th August there were some incidences of motion sickness however these were generally limited to children, and the crew noted that they seemed more susceptible. Some motion sickness was to be expected for a vessel operating in larger waves and rougher seas.

There are a number of actions that should be improved to enhance passenger safety when there is a possibility of the vessel rolling to more than 11.5°. These actions should include but are not be limited to:

- 1. Based on the additional analysis and understanding of the vessels motions and as required by section 4.2.4 of HSC 2000 [Ref 1], warnings should be provides to passengers and crew to make them aware of how the vessel performs. These warnings may be most effective if targeted specifically towards occasions when conditions are similar to those that have been known to cause larger rolling motions in the past.
- 2. Ask people on board to remain seated, this only needs to be done when there is a possibility of larger roll motions occurring. By being asked to remain seated, if passengers need to move around the vessel they are likely to do so with more caution.

5.4. Conclusions

The ability of the Condor Liberation to maintain average speeds over 30 knots in sea-states with a significant wave height over 3m is exceptional. Given the conditions experienced in the English Channel on a regular basis this capability is advantageous to her operation.

Analysis of vessel telemetry has shown that the ride control system is able to effectively damp the motions of the vessel without the need for the vessel to reduce speed in a seaway, in conditions with wave at the upper end of the permit to operate the vessel is comfortable with only limited rolling and pitching.

In larger sea states, not directly on the bow or stern, when the motions of the previous catamarans would become very uncomfortable the motions of the Condor Liberation are still very well controlled and comfortable, however she has been shown to occasionally roll to larger angles. These motions may occur with little warning for passengers and as a result the passengers find these occasional larger roll motions disconcerting. The larger roll motions have been known to occur on both the north and southbound legs of the round trip, between the islands, between Guernsey and the Casquets and in mid channel. These motions do not present a risk to the vessel due to the large reserve stability.

5.5. Recommendations

Condor are actively working with Austal to understand the conditions where there is a risk of larger roll motions occurring. Further ongoing investigation is required to better understand the behaviour of the vessel. This understanding will enable effective weather routing to be developed along with targeted passenger communication

If the Condor Liberation continues to occasionally exhibit large roll motions then it is important that the causes and effects of these motions are better understood. Understanding of this could have helped, by either a programme of tank testing or a carefully managed set of sea trials.

When encountering conditions which are similar to those that have been known to cause larger rolling motions in the past, warnings should be provided to the passengers regarding the potential vessels motions and advising passengers to remain seated. Condor have confirmed that this has been implemented.

As the vessel motions become better understood, weather routing should be implemented to reduce the likelihood of large roll angles occurring on board. Condor are developing a strategy for weather routing of the Condor Liberation.

Condor should request from Austal the vessel telemetry from the customer sea trials as this would assist the generation of the best guidance for the master to be determined for the operation of the vessel during larger roll events.

6. STRUCTURAL APPRAISAL

The terms of reference require that a verification of the structural characteristics of the vessel be undertaken.

Structural drawings of the vessel were not available at the time of writing, therefore a survey of the vessels structure was undertaken comprising an initial structural survey of all compartments within the main hull and compartments in the amah hulls above the tank top. A structural survey is the most effective way to observe the ability of the arrangement of the structure to withstand to loads on it in service and the efficacy of any repairs undertaken.

The structural configuration of the Condor Liberation is typical of Austal trimarans with a larger central hull linked through cross decks to two buoyant side hulls known as amahs, which provide additional stability to the main hull. The entire hull structure is fabricated from marine grade aluminium.

The construction of the bottom and side shell structure of the vessel is typical of high-speed craft with the shell plating supported by extruded longitudinal stiffeners which in turn are supported by fabricated floors or web frames. The decks are fabricated from extruded panels known as planking.

The structural surveys were undertaken on the 16th of July and the 26th of August. During the survey the following structural damage and corresponding repairs were noted:-

- 1. Area where the port side fendering and amah hull had been damaged by contact with the vertical steel piling in St Peter's Port Guernsey.
- 2. Areas of structural deformation and damage to the Port and Starboard wetdeck structure located outboard of the workshop between frames 48 and 56.

6.1. Damage to Port Side Fendering

On Saturday 28th March 2015, Condor Liberation suffered minor damage to the port amah, having landed quite heavily against a cylindrical single steel vertical cylindrical piling whilst berthing at No. 1 berth in St Peter Port, Guernsey [Ref 5] and [Ref 6].

The point load nature of the impact caused damage to the protective belting on the ship between frames 32 and 36 (which is designed to protect the hull of the ship in case of impact), but also caused deformation to some internal frames and minor hull penetration into a void space. The damage was above the water line.

The damaged area has been repaired to the satisfaction of the DNVGL surveyor.

6.2. Port and Starboard Side Wet Deck between the Bulkhead at Frames 48 and Frame 56

The damage comprises of the wet deck plating being set upwards causing plate buckling of the floor structure overall, but most severely in way of the connection to the wet deck plating.

The temporary repair of all these damages has been effectively completed to DNVGL's satisfaction. Condor have instigated a regular inspection programme of the temporary repairs, with any further damages being reported to DNVGL. Permanent repairs will be made during the next scheduled docking of the vessel.

We have undertaken an inspection of the areas aft of frame 48 and forward of frame 56 and can find no further damage of a similar nature, except some small deflection on the Web frame in the Main Deck forward of the mooring areas port and starboard at frame 48.

6.3. Conclusions

The Condor Liberation has been built to a high standard. Her style of structural arrangement is necessary for the vessel to achieve the required transit speed and deadweight capacity.

The damage sustained to date is not uncommon on high speed craft, with temporary repairs implemented to enable effective permanent repairs to be made at a scheduled dry docking. In has been Houlder's experience that an ongoing programme of structural maintenance on high speed light craft is not uncommon to maintain the structure.

All repairs, to date, have been carried out to the satisfaction of attending DNV GL surveyors

6.4. Recommendations

Condor should continue to undertake regular weekly inspections of the areas of wetdeck damage outboard of the workshop between frames 48 and 56 until full permanent repairs have been undertaken and proven to be satisfactory.

7. REVIEW OF BERTHING INCIDENT ON 28TH MARCH 2015

On the 28th March 2015 the Condor Liberation suffered minor damage to the Port amah having landed quite heavily against the southernmost vertical cylindrical steel fender while berthing in St Peter Port Guernsey, see Figure 6. Damage was sustained to the belting and hull plating of the amah in way of frame 35 at a height of approximately 1.0m above the waterline. The damage extended from frame 32 to 36.

The damage was caused by hard contact with the single fender.

Houlder has reviewed the berthing incident summary report prepared by Guernsey Harbours [Ref 5] and Condor's incident investigation report [Ref 6]. The reports indicate that an appropriate in depth investigation was undertaken into the incident.

From these reports, Houlder notes the following:-

- 1. The wind at the time of berthing was 28 knots gusting to 32 knots which is at the limits of the Route Operating Manual [Ref 7] guidance on berthing
- 2. The master's familiarisation with the vessel had not permitted a full assessment of the vessel's capabilities due to more benign weather conditions for handling tests, undertaken prior to the Condor Liberation entering service.
- 3. The vertical steel cylindrical pipes that comprise the berth fendering in St Perter Port are suitable for large steel vessels and have not been designed for a HSC of the Condor Liberations construction.
- 4. Shortly after the Condor Liberation had suffered damage on berth 1, the Condor Rapide berthed without incident at berth no 2.



Figure 6 Typical Dolphin at St Peter's Port that the Condor Liberation landed against hard

8. BERTH FIT REVIEW

Houlder has reviewed the suitability of the vessel to berth in the Channel Ports. We have therefore:-

- 1. Summarised the differences between the Condor Liberation and the previous catamarans that Condor are used to berthing in the port.
- 2. Undertaken a study to assess the manoeuvring capability of the vessel, this was undertaken as a station keeping assessment.
- 3. Provided Condor with sketches of the Berth Fit for the Condor Liberation for both the ports of Guernsey and Jersey.
- 4. Undertaken a study to assess the capacity of the vessel to absorb berthing loads.

8.1. Differences between the Condor Liberation and the Condor Catamarans

There are differences between the manoeuvring characteristics of the current Trimaran and previous catamaran vessels.

The catamaran is manoeuvred using 4 waterjets, with 2 positioned on each hull. The widely spaced waterjets enable the master to generate large turning moments by varying the thrust from each of the sets of waterjets on each hull. Having 2 waterjets on each hull gives a system with inherent redundancy.

The Trimaran has 3 waterjets, however these are close together on the centre hull. As it is not possible to generate the same turning moments with the waterjets in this formation, the vessel is equipped with two bow thrusters. These enable the large moments to be generated and to enable better control the bow of the vessel.

While the combination of bow thrusters with waterjets is not unusual, it is unfamiliar to Condor's recent experience with their catamarans. Greater familiarity with the response of the vessel is expected to improve the Masters ability to berth of the vessel.

In addition, as part of Condor's customisation process, bridge wings have been fitted to the Condor Liberation to assist in berthing the vessel in all weathers. The bridge wings afford the master a good view of the quayside with vessel controls to hand. This is a similar arrangement to that on the previous Condor catamarans

In the case of the previous catamaran vessels the incidences of cargo damage and also passenger motion sickness were both more likely. This implies that the seakeeping would limit the operation of the vessel at times when berthing was still practical for this vessel. The seakeeping of the Condor Liberation enables her to operate in higher sea states and rougher weather with significantly reduced risks of cargo damage and motion sickness. To date recorded cargo damage has been limited to a small number of motorcycles.

Due to the limited number of incidences of cargo damage during any period it is difficult to provide a meaningful statistical evaluation of the reduction cargo damage. However, the Condor Liberation has yet to experience any significant cargo damage, in spite of larger roll motions on a number of occasions.

It is expected that the increased operability of the Condor Liberation will lead to her regularly operating in higher the wind strengths and this would cause the conditions she is expected to berth in to also increase. The increased operability is more likely to be limited by the vessel's ability to berth.

8.2. Station Keeping Capability

The ability of the vessel to hold station in adverse conditions has been calculated by Austal and this data has been included in the operations manual for the vessel [Ref 7].

Houlder has undertaken a dynamic positioning capability assessment on this vessel, this is a calculation of the vessels ability to maintain her position against combinations of wind, waves and current from different directions. Based on the information available at the time of undertaking our calculations, there was nothing to suggest that dynamic positioning capability plot [Ref 7] was not realistic. It is noted that Austal have undertaken model testing as the result of an extensive research programme and as such have a large data set available to them when predicting the capability of this vessel.

8.3. Port Infrastructure

In general high speed craft tend to have dedicated berths with vessel specific infrastructure that can be designed to accommodate a specific vessels requirements. This would include specific fendering which could spread berthing loads over a large area and be more flexible to reduce impact accelerations and hence the likelihood of damage when berthing. This has not been implemented in Guernsey or Jersey due to the number of different vessels that are required to use these berths.

8.4. Guernsey Berth Fitting

8.4.1. Berthing Drawing

The berthing of the Condor Liberation in Guernsey has been checked against the available port infrastructure. It is of note that there is only 22.5m between a vessel on No 2 Berth and the dock wall, on the adjacent berth to Port. This can become an issue if another vessel is alongside in this location as the space available for berthing becomes very limited.

8.4.2. Berth Modifications / Fendering

The dockside fenders consist of steel cylindrical piles mounted on large rubber mounts. Although these resiliently mounted piles are capable of absorbing the berthing energy imposed by larger vessels than the Condor Liberation, the rubber mounts are therefore likely to be too stiff for a light high speed craft such as the Condor Liberation.



Figure 7 Mooring dockside fenders Guernsey No 2 Berth

Due consideration should be given to appropriate vessel modification and also to any infrastructure changes that would increase the contact area to and reduce the relative stiffness of the shore side fendering in the interface between the vessel and the dock wall.

8.5. Jersey Berth Fitting

8.5.1. Berthing Drawing

The berthing of the Condor Liberation in St Helier, Jersey has been checked against the available port infrastructure. It is noted that the dockside fender on the western berth are more appropriate for protecting the larger steel vessels. Fendering on the Eastern berth where the Condor Liberation is more likely to berth are more appropriate but also expected to lack the flexibility of fendering specifically designed for a light high speed craft.

The combined width of the two berths in St Helier is approximately 90m.

8.5.2. Berth Modifications / Fendering

Due consideration should be given to appropriate vessel modification and also to any infrastructure changes that would increase the contact area to and reduce the relative stiffness of the shore side fendering in the interface between the vessel and the dock wall.



Figure 8 Example fender in Jersey (Eastern)

8.6. Poole Berth Fitting

The dockside fenders in Figure 9 consist of 1200mm wide fender panels flexibly mounted on rubber mounts attached to the Quay. The fendering at this berth in Poole is tailored for high speed craft, and recent modifications are evident to extend the fendering for the Condor Liberation.



Figure 9 Typical fender in Poole

8.6.1. Berth Modifications / Fendering

The berth in Poole is most suited to high speed craft and has been modified to suit the Condor Liberation. However it is still considered prudent to check the fendering design to verify whether the contact areas and fendering stiffness is compatible with the Condor Liberation.

8.7. Conclusion

- 1. The improved operability of the Condor Liberation due to her better seakeeping is not matched by a similar improvement in the berthing capability.
- 2. The Condor Liberation appears to demonstrate different berthing capability when compared to the previous Condor catamarans. Some of this difference may be attributed to a lack of familiarity with the vessel.
- 3. The dockside fenders in the Channel island ports appear to be designed to accommodate much larger vessels, requiring more robust dockside infrastructure and stiffer connections between the vertical fender and the dock wall than would be expected on a dedicated berth for a vessel like the Condor Liberation.
- 4. A reduction in the stiffness of the connection between the vertical fenders and the dock wall along with an increase in the surface area of the contact point with the vessel would provide a more suitable dockside interface for a vessel like the Condor Liberation and reduce the risk of damage during docking in adverse conditions.

8.8. Recommendations

- 1. If the full benefits of the Condor Liberations seakeeping performance are to be achieved, Condor should consider how additional berthing capability can be best achieved. As part of a cost / capability trade off study the options for vessel modification should be considered.
- 2. Modifications to the shore side fendering should be investigated to determine what options are available to increase the contact area with the Condor Liberation's belting and to reduce the stiffness of the connection to the Dock side.
- 3. Options for strengthening the Condor Liberation's belting structure should be investigated.

9. RELIABILITY

9.1. Main Propulsion

The vessel is powered by 3 MTU 20V8000 M71L engines producing up to 9.1MW each. Each engine drives a single steerable waterjet through a ZF gearbox.

Electrical power is provided by 4 dedicated MTU diesel generators.

The vessel has a service agreement with MTU [Ref 9], to ensure the timely correction of any engine issues.

The service agreement with MTU sets limits on the operation of the main engines and retrospective assessment of engine operation is required to confirm the operating point that has been used.

9.2. Reliability and Warranty

At the time of writing this report Condor Liberation had 3 cancelled sailings due to issues with the main engines and exhausts.

9.3. Warranty Items

Condor are maintaining a record of warranty items and these are addressed by Austal.

9.4. Planned Maintenance

The planned maintenance system used on board is the system used on other Condor vessels so is known to all personnel that have to operate the system and to input data. Condor have allowed input from Ship's staff so that a Planned Maintenance System suitable for the Condor Liberation is produced. This will take time as items noticed during the vessel's operation are included in the system. Time scales for overhaul/maintenance can be adjusted once the service life of the equipment is known. The ship uses Condition Monitoring equipment to assist with this.

9.5. Conclusion

The main engines have experienced some reliability issues which have affected the vessel's punctuality and reliability. Condor and Austal are working with MTU to find the best way forward and reduce the risk of further disruption.

Whilst there are other reliability issues these are considered to be inevitable with the introduction of a new vessel and are well addressed by Condor and when appropriate Austal, as the builders of the vessel.

9.6. Recommendations

Condor should review the operating point used for the main engines to ensure they are operated within the terms of the service agreement.

10. SPEED AND PUNCTUALITY

Houlder has received data for the arrival and departure times for all scheduled channel crossings from the 28th March through to the 17th September 2015 [Ref 10].

AIS track data for the vessel has been gathered directly from Marine traffic [Ref 11]. This is a log of the position data for the vessel that must be reported by statute. This has been used in conjunction with the vessels GPS log. This data has been correlated against the cargo manifest, sea state and wind strength data recorded in the Condor Punctuality log.

10.1. Speed

A speed assessment has been undertaken by calculating the average speed of the Condor Liberation when not limited by wash abatement restrictions or Harbour speed limits. In order to discount these parts of the journey, the Condor Liberation has therefore been assumed to be operating at her transit speed when the ship's speed is over 18 knots.

The average speed of the vessel when underway since entering into service up to the 17th September was 32.2 knots.

It is noted that the vessel achieved an initial speed of 32.9 knots on the endurance trial with all three engines assumed to be operating at 100% MCR, and a deadweight of 633 tonnes. Based on the drafts recorded the vessel had an initial displacement of almost 1700t, this is close to the maximum displacement of 1725t. [Ref 12].

Based on this and assuming the vessel is operated at 90% MCR we would expect a speed of approximately 31.8 knots to be achieved. This is comparable to the speed reported in the 90% MCR Speed trial reporting a speed of 31.4 knots. [Ref 12].

It is noted that the MTU service agreement limits the engine operating point to an average of 85% MCR. The achievable speed based on this powering is expected to be at least 0.5 knots less than is achievable at 90% MCR.

Figure 10 illustrates the impact of sea state on the passage making ability of the vessel. The vessels average speed is reduced by approximately less than 1.0 knot across the range of sea states assessed. Based on discussions with the master following a rough weather crossing they felt no need to reduce speed in higher sea states. The vessel does not slam and it is noted that flow over the T foils enables the ride control system to generate a larger maximum force and this gives the potential for more effectively damping of the vessel motions.

Figure 11 shows that there is virtually no influence of wind strength on speed.





Figure 10 Variation of Transit Speed with Wave Height

Figure 11 Variation of Transit Speed with wind strength

Figure 12 illustrates the influence of the number of cars loaded on the transit speed. The average transit speed for the Condor Liberation is 33.7 knots with up to 100 cars loaded. This reduces to 31.7 knots when over 150 cars are loaded. Given the vessel transits for 202nm on a complete round trip, this speed reduction equates to ~23 minutes during the day.



Figure 12 Variation of Transit Speed with cars loaded

Fuel carried will also affect the speed of the vessel with the transit speed on the Northbound channel crossing 1.1 knots greater than the southbound crossing. This difference is expected as the more weight that is carried by the Condor Liberation when transiting the more power required to maintain a given speed. As the vessel takes on fuel in Poole on a daily basis she is expected to be quicker on the return leg, some of this could be due to tidal currents affecting the speed over the ground.

10.2. Punctuality

10.2.1. Methodology

The arrival and departure times for the Condor Liberation have been compared against the schedule. Within the context of this assessment, and as presented in Table 1, the vessel is considered to have achieved a "timely arrival" if she arrives within 30 minutes of the scheduled arrival time. This is the 30 minute time limit for a "Moderate Delay" on the high speed channel crossings as defined in the Operating Agreement between Condor and The Harbour Master of Jersey. The vessel is considered to have arrived when the ship is alongside the berth. The departure time is taken on leaving the berth when the vessel is underway.

The punctuality data is split into monthly performance and is declared at face value. The average performance to date and also over the last 50 days for which records are available has also been reported. In this assessment no distinction has been made between delays that may or may not be attributed to "fault events" or "no fault events" as defined in the Operating Agreement.

10.2.2. Analysis Punctuality

The punctuality of the vessel consistently reduces through the round trip, as shown in Table 1. For example, in the last 50 days the Condor Liberation arrived in Guernsey from Poole on time 87% of the time, however she arrived back in Poole on time at the end of the day 57% of the time. This indicates the vessel is not able to make up lost time during the voyage.

-								
	Apr	Мау	June	ylul	Aug	Sept	Overall	Last 50 Days
Poole to Guernsey	83%	76%	90%	86%	80%	95%	84%	87%
Guernsey to Jersey	74%	65%	90%	78%	73%	95%	78%	80%
Jersey to Guernsey	80%	55%	89%	78%	73%	89%	76%	78%
Guernsey to Poole	73%	24%	84%	70%	50%	67%	60%	57%

Table 1 Timely Arrivals

2	Apr	May	June	ylul	Aug	Sept	Overall	Last 50 Days
Poole to Guernsey	71%	85%	77%	51%	59%	82%	64%	67%
Guernsey to Jersey	35%	65%	48%	32%	39%	47%	38%	42%
Jersey to Guernsey	32%	61%	43%	32%	35%	53%	35%	40%
Guernsey to Poole	35%	33%	42%	24%	15%	62%	29%	31%

Table 2 Early Departures

As the crew become more familiar with operating the vessel the timeliness of the operation is likely to improve and the turnaround times would be expected to reduce. The vessel's speed on passage is unlikely to change significantly. There is an awareness on board the Condor Liberation of the importance in keeping to the timetable. With this in mind the crew will aim to leave port as soon as practicable, and ahead of scheduled departure times when they can. Table 2 shows the proportion of departures that were in advance of the scheduled time. In the first half of September the vessel left Poole before her scheduled departure time 82% of the time. This has helped in achieving 95% timely arrivals in both Guernsey and Jersey on the outbound legs of the journey.

The current timetable may benefit from additional time to enable time lost to be recovered and reduce consequential delays in the schedule. However we understand that it is difficult to add this into the vessels schedule due to statutory constraints on manning hours.

10.2.3. Transit and port turnaround time

To better understand the time spent on each phase of the round trip, each leg has been split into 4 phases. The average time spent by the vessel in each of these phases, and in each month to date is presented in Table 3. The phases have been defined such that they can be identifiable from ships speed from the AIS and GPS data available.

- 1. Transit to Open Water. The time spent leaving the berth, from the moment the vessel is underway to the point she accelerates through a speed of 18 knots. This is the point where any wash restrictions or port limits are passed.
- 2. Time on Passage. The time spent above a speed of 18 knots, when the vessel is underway at her transit speed.
- 3. Transit to Berth. The time spent at a speed of less than 18 knots manoeuvring onto the berth. In part due to the vessel backing into the berth, this time is longer than the time spent transiting to open water.
- 4. Port turnaround. The time spent stationary at the berth.

The overall round trip is allocated 10 hours. The vessel has often taken longer than this to make the round trip.

The time spent at manoeuvring speeds to and from the berth in Poole is 68 minutes. This constitutes a significant proportion of the overall time allocated for the round trip.

The average distance travelled above 18 knots is 76nm across the channel and 25 nm between the islands. The total distance travelled at the transit speed for the round trip of 202nm.

The average passage making speed on all crossings was calculated to be 32.2 knots. This would need to be increased to 35.0 knots to reduce the round trip

time by 30 minutes, if the transit times, and port turnaround times are not reduced.

To better understand the performance of the vessel against the schedule the round trip has been split into 15 phases as show in Table 3. Each phase would need to be reduced by 2 minutes to achieve the same effect.

Prepared by Houlder Ltd

Route	Phase	Schedule	April	Мау	June	ylul	Aug	Sept	Overall	Last 50 Days
	Transit to Open Water		31	29	29	29	29	30	29	29
Poole to Guernsey	Time on Passage	180	148	145	144	145	151	149	147	150
	Transit to Berth		15	12	12	15	12	12	13	12
Guernsey	Port Turnaround	30	37	42	32	31	29	29	33	29
	Transit to Open Water		6	6	6	7	6	5	6	6
Guernsey to Jersey	Time on Passage	60	46	47	45	45	48	47	46	47
,	Transit to Berth		14	13	12	13	13	13	13	13
Jersey	Port Turnaround	60	57	62	59	56	55	55	57	55
	Transit to Open Water		7	6	6	6	6	6	6	6
Jersey to Guernsey	Time on Passage	60	46	46	45	45	48	46	46	47
,	Transit to Berth		12	12	11	12	11	11	12	11
Guernsey	Port Turnaround	30	39	42	34	32	36	33	36	35
	Transit to Open Water		6	6	6	8	6	6	6	6
Guernsey to Poole	Time on Passage	180	142	141	134	135	147	144	140	145
	Transit to Berth		40	39	39	39	38	41	39	39
	Round trip	600	645	648	614	617	634	628	631	631
Poole	Port Turnaround	na	85	82	62	92	73	96	84	84

Table 3 Condor Liberation average time in journey phases

The vessel aims to leave early to enhance the timeliness of the service. Early departures are expected to continue to assist the vessel in meeting the schedule.

When the Condor Liberation first came into service there was some difficulty experienced in loading her. This can be seen in the port turnaround data. The time take to turn the vessel around in each port has reduced significantly from when the Condor Liberation first entered service.

Some further reductions in the port turnaround times can be expected, although there will be a minimum time necessary for this phase.

10.3. Conclusions

The speed of the vessel on passage is not significantly affected by either wind strength or the sea conditions. The average speed of the vessel reduces from 32.5 knots to 31.7 knots across the range of sea states observed to date.

The speed of the vessel reduces as more cars are carried with the vessel being 2 knots slower when heavily laden with more than 150 cars when compared to crossings with less than 100 cars on board.

The Condor Liberations ability to make good speed while maintaining passenger comfort in higher seas is not well represented by analysis of punctuality data due to the lack of margin within the schedule. Where the previous Condor catamarans may have been heavily delayed due to weather the Condor Liberation is able to maintain a high transit speed.

Analysis of data shows that punctuality on arrival back in Poole from Guernsey at the end of the day (57%) is significantly worse than for arrival in Guernsey from Poole (87%). There is little opportunity to make up any lost time during the day. Whilst it may be desirable to schedule extra time in the timetable, statutory manning hours limitations impact on the practicality of this.

It is understood that the vessel will leave Poole early when possible. This has helped to improve the timeliness of the service.

10.4. Recommendations

The timetable should be reviewed for the coming season to investigate options for improving punctuality.

11. CONCLUSIONS

Houlder have conducted a review, as planned, of the Condor Liberation the scope of which is as follows:-

- 1. Safety
 - a) Verification of the vessel's stability
 - b) Verification of the vessel's structural characteristics
- 2. Suitability based on the existing infrastructure and the likely sea conditions in the English Channel
- 3. Performance the reliability, punctuality, speed and ride comfort of the vessel.

From that review we have concluded:-

- 1. The Condor Liberation has no stability issues.
- 2. The rolling motion associated with the trimaran hull form is generally less frequent than the roll motions of a catamaran (and hence generally more comfortable), however the nature of a trimaran hull leads to roll angles larger than those experienced on the catamarans previously used on the service.
- 3. Condor and Austal are further investigating the wind and wave combinations that lead to these roll angles with a view to choosing operational arrangements that will limit the impact of these motions.
- 4. The damage sustained to date is not uncommon on high speed craft, with temporary repairs implemented to enable effective permanent repairs to be made at a scheduled dry docking. In has been Houlder's experience that an ongoing programme of structural maintenance on high speed light craft is not uncommon to maintain the structure.
- 5. The bow thruster water jet configuration of the Condor Liberation gives the vessel different berthing capabilities to those that the previous smaller catamarans had. It is recommend that Condor undertake a cost benefit analysis of potential means of improving the berthing capability of the vessel.

APPENDIX 1 - AUSTAL VESSEL DATA SHEET

RRAN

AUTO EXPRESS 102



PRINCIPAL DIMENSIONS

Length overall Length (waterline) Beam (moulded) Hull depth (moulded) Hull draft (maximum)	102.0 metres 101.4 metres 27.4 metres 7.6 metres 4.5 metres
PAYLOAD AND CAPACITIES	
Passengers Vehicles Heavy vehicles Clear heights Trucks under raised mezzanine Cars under mezzanine deck Cars over mezzanine deck Maximum deadweight	880 in 3 lounges 245 cars 188 lane metres for trucks and 137 cars e deck 4.30 metres 2.25 metres 1.85 metres 620 tonnes
PROPULSION	
Main engines Gearboxes Waterjets	3 x MTU 20V 8000 M71L 9,100 kW @ 1,150 rpm 3 x ZF 53800 3 x Wartsila LJX 1300
PERFORMANCE (with Ride C	Control fitted)
Speed 37 knots (90% MCR, Range	, 390 tonnes DWT); 34 knots service speed 660 nm @ 90% MCR

CLASSIFICATION

Germanischer Lloyd

№ 100 A5, HSC - B OC3 High Speed Passenger / Ro-Ro Type, MC, AUT Bahamian Flag Authority

+ 20% reserve or 940 nm









CONDOR LIBERATION

D EXPRESS 102

Vessel type: 102m Vehicle-Passenger Trimaran

PROFILE





CONDOR LIBERATION

YARD NO: 270

DESTINATION: UNITED KINGDOM

DELIVERY: 2014

CLIENT: CONDOR FERRIES

100 Clarence Beach Road | Tel +61 8 9410 1111 Henderson Western Australia 6166

Fax +61 8 9410 2564 sales@austal.com www.austal.com

APPENDIX 2 - TERMS OF REFERENCE LETTER

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COMMERCE AND EMPLOYMENT



Economic Development Department

Mr R Kew Executive Chairman Condor Ltd New Jetty Offices White Rock St Peter Port Guernsey GY1 3AF

10 July 2015

Dear Mr Kew

Thank you for providing a copy of the final version of the Terms of Reference to be entered into between Condor Ltd ("Condor") and Houlder Ltd ("Houlder") relating to the provision of an independent report to Condor, the States of Guernsey and the States of Jersey into the safety, suitability and performance of Condor Liberation (the "Houlder Report").

We acknowledge that both the States of Guernsey and the States of Jersey (the "States") have been consulted on the Terms of Reference and have been kept appraised of Condor's internal procurement process which, they now understand, has resulted in the Board of Condor awarding the contract to Houlder. We understand that in the Board's view Houlder are independent of Condor and were awarded the contract based on their detailed analysis and response to the brief. We have no reason to question the commercial judgement of the Board.

The States understand that Houlder will provide Condor with a working document during the duration of their investigations that will focus on any technical issues relating to the construction or performance at sea of Condor Liberation ("Technical Document").

It is agreed between the parties that the Houlder Report will be provided to the States and to Condor at the same time and shall comprise the final detailed findings of the Technical Document together with an executive summary in such format as is capable of being published as a matter of public record by the States.

We look forward to receiving the Houlder Report in due course and to what we hope will be a further step towards achieving the success promised by Condor Liberation.

Please sign and return a copy of this letter (enclosed) acknowledging your agreement to the publication of the Houlder Report on the terms of this letter.

Yours sincerely

Kevin A Stewart Chairman External Transport Group Guernsey

Lyndon Farnham Minister Economic Development Department Jersey

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