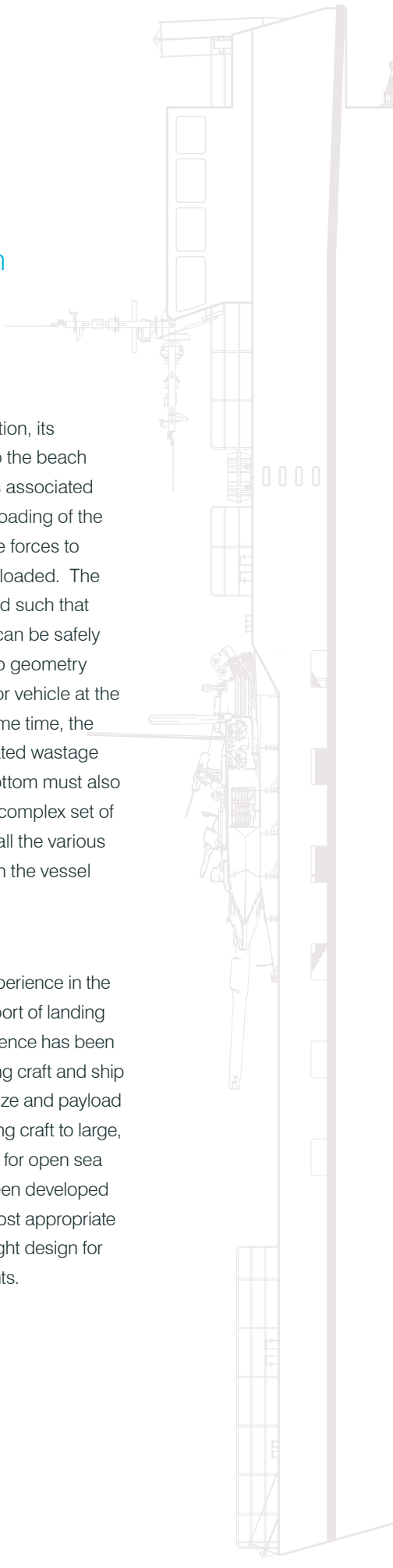
CAIMEN®

A range of landing craft
and landing ships

Contents

Introduction

Landing craft are an essential part of the system required to deliver amphibious forces, vehicles, equipment and supplies to a beachhead.



However, they are also engaged in logistics and transportation of vehicles and material between ports and theatres of operation and increasingly can be used in more flexible ways to support small boat operations, conduct humanitarian missions and other operations requiring a vessel with a flexible cargo space and payload capability.

The casual observer may categorise the landing vessel as a simple type, as they lack sophisticated naval mission systems or weapons. However, far from being 'simple ships' the design of landing vessels poses some unique and often challenging problems to naval architects and engineers. The increasing speed and safety aspirations for the next generation of landing craft further exacerbate these issues.

Design Challenges

One of the most unique aspects of landing craft is the requirement to ground the vessel repeatedly on unprepared and frequently uneven and rough beach surfaces. Designing for controlled beaching of a landing craft or larger landing ships requires careful analysis of the ship's loading condition, its draught and trim relative to the beach and its gradient, the forces associated with the initial impact, the loading of the hull when beached and the forces to extract the vessel when unloaded. The beaching must be achieved such that the vehicle or other loads can be safely moved, based on the ramp geometry and a safe fording depth for vehicle at the end of the ramp. At the same time, the consequences of accelerated wastage and abrasion of the hull bottom must also be remembered. This is a complex set of assessments, needed for all the various loading conditions in which the vessel may operate.

BMT's Experience

BMT has many years of experience in the design and in-service support of landing craft and ships. This experience has been applied to a range of landing craft and ship designs spanning the full size and payload range from small fast landing craft to large, high payload landing ships for open sea voyages. The range has been developed to allow BMT to offer the most appropriate solution and develop the right design for specific project requirements.

CAIMEN® Range of Landing Craft and Ships

The Caimen range of landing craft and ships have been developed over time to meet a range of customer requirements and expands across the characteristics from smaller landing craft deployable from larger ships to heavy landing ships capable of self deploying.

The standard designs range from 28m through to 115m length.

Two principle design variants have been developed; a fast landing craft featuring the innovative tri-bow hullform and a larger monohull designed for seaworthiness, endurance and capacity.

CAIMEN® considers the interaction with the beach to be a fundamental element of the vessel, and in addition to the bow ramp design, this interaction flows down into a range of other aspects of the design. For example, BMT uses bespoke tools to understand the balance of friction when beached, hydrodynamic loads, approach speed and extraction capability to ensure that CAIMEN® can be beached and recovered to sea under her own power. Vessel systems are designed to allow this, with the waterjets or propellers coupled with a high holding power kedge anchor system for additional extraction capability in surf or in moving water.

Operational flexibility is a key part of the CAIMEN® design, and this is evidenced through aspects such as the deck layout. At the design stage, BMT provides a layout that matches the necessary combination of accommodation, technical spaces, deck equipment and payload space. The deck is then laid out in such a manner that a significant range of military and commercial vehicles can be carried, all safely tied down for transit. Further capabilities such as provision for embarked forces or modules to provide additional capabilities can be included.

CAIMEN®-60

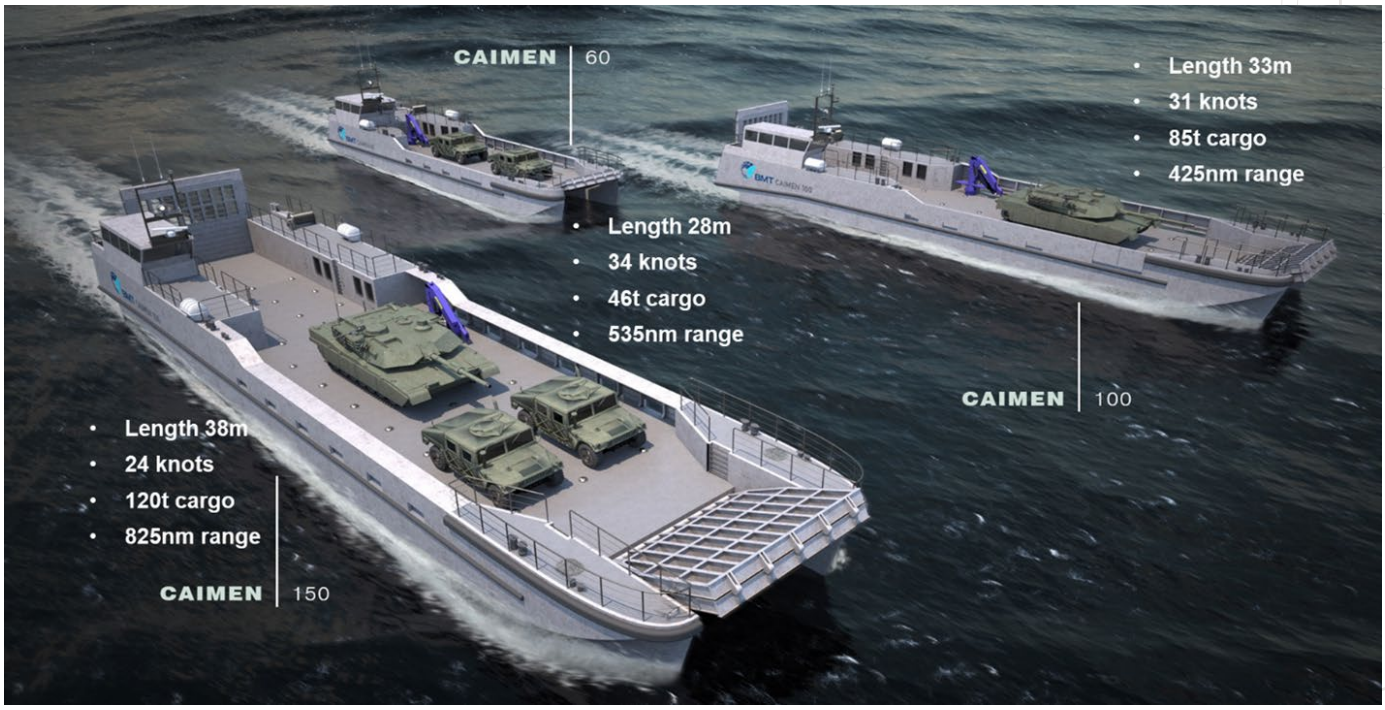
CAIMEN® Fast Landing Craft

Standard CAIMEN® range of Fast Landing Craft

In response to emerging requirements to distance amphibious forces further from the beach, coupled with a requirement for the provision of highly flexible multi-role amphibious operations, BMT has developed a range of fast landing craft under the family of CAIMEN®, all of which offer huge advances in connector performance.

The range of CAIMEN® fast landing craft designs spans from the CAIMEN® 60 (with 60t capacity for payload and fuel), through the CAIMEN® 100 (which can carry a main battle tank at 85t), to the CAIMEN® 150 (with a 120t payload capacity). The range of vessels offer speeds of more than 30 knots, coupled with the variety of payload carrying capabilities shown.

This simplicity of design supports platform availability, maintainability, and life-cycle cost. CAIMEN® can operate at high speeds with heavy payloads, allowing faster amphibious operations, such as offload from a host ship, or a range of independent shore to shore activities, compared with slower, more conventional landing craft.



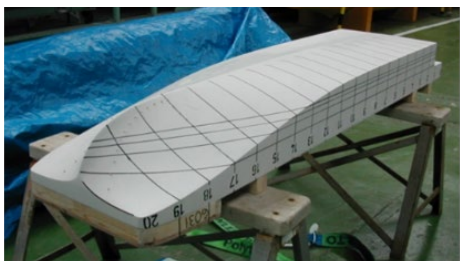
CAIMEN® Fast Landing Craft continued

CAIMEN® Tribow Hullform

At the heart of the CAIMEN® fast landing craft concept is the unique tribow monohull hullform. This innovative yet deceptively simple design provides the following crucial capabilities, all of which provide fundamental advantages when compared with more conventional landing craft:

- Ability to deliver high speeds of 30+ knots when in lighter payload conditions and even 20+ knots while carrying a main battle tank.
- Superior seakeeping and stability when operating in high sea states, and at high speed with a heavy payload, offering enhanced motions (for crew comfort and payload lashing) and minimal speed reduction in waves.
- Design for shallow water operation in littoral environments and within inland waterways.
- High manoeuvrability at all speeds, including at slow speed and in close quarters operations.
- Specific design for stability when engaging with the beach, floating causeway systems, mother ships and piers for payload transfer. The inherent beach stability provided by the tribow forward shape provides confidence in the safe and efficient delivery of troops and vehicles.
- Ability to scale the hullform for use at different vessel sizes and speeds.
- Triple waterjet arrangement, providing protected propulsion for shallow water operations and manoeuvrability, coupled with significant propulsion redundancy.
- Design for beach extraction where due to a raised central waterjet, a minimum of one waterjet is available for use even in fully beached scenarios, providing self-propelled beach extraction capability.

The CAIMEN® fast landing craft hull design has been developed by BMT over a period of over 10 years, founded on a programme of development that has included two major tank testing programmes with Government customers. Tank testing has included conventional towed tests but also free running light and heavy payload tests at high speeds/ high sea states and also slower speed very heavy weather survivability. This provides customers with significant pedigree for the performance of the hullform and provides a huge amount of design information in critical areas such as hull structural loadings, bow loadings, water flow in the tunnels and more.



‘Conventional’ Monohull.

‘Hybrid’ Semi-tunnelled.

‘Tribow’ Tunnelled.

CAIMEN® Fast Landing Craft continued

Critical design features of CAIMEN® Fast Landing Craft

In addition to the strong design foundation that is provided by the tribow hull, several critical further design aspects provide the necessary characteristics for the craft to be successful for operation in onerous landing craft roles.

CAIMEN® provides a range of ramp options, including drive through capability with a stern ramp and a bow ramp, which allows for loading from stern to bow. The bow ramp has been developed to be a hydraulically deployed bi-fold arrangement.

From a structural perspective, the design provides a suitable compromise between a structure that is robust, whilst also light weight for the high-speed CAIMEN® variants. The design can be provided in aluminium or steel, and in both cases BMT achieves a Class approved structure. In addition to standard Class requirements, the CAIMEN® design has been developed to address structural requirements specific to landing craft, such as: ramp interface loads; interface strong points for marriage with mother ships or floating causeways; deck and hold-down for payload carriage in high sea states; robustness for beaching and surf operations.

Many of these specific landing craft structural aspects have required innovative structural design from first principles and using sophisticated structural analysis tools, coupled with knowledge of how the vessel will be operated. As such, customers are provided with a design that provides a level of confidence for challenging operations.

Systems on board the CAIMEN® platform reflect a huge amount of BMT experience in designing high speed light craft, but they also reflect characteristics necessary for operation as a landing craft. For instance, engine cooling systems are designed for use in very shallow water, or when partially beached. The CAIMEN® Fast Landing Craft family provides an innovative and sophisticated design, coupled with strong pedigree and robustness for military customers.

Whilst conceptually a straightforward piece of equipment, the ramp design is in fact highly sophisticated, whilst also maintaining a philosophy of robustness:

- The geometry allows for suitable vehicle fording depths on a range of beach gradients, and suitable clearances when landing on floating causeway systems or mother ship stern gates.
- The structure is critical for acceptance of the extremely high vehicle wheel and track loads, as well as significant torsional requirements when landing on an uneven beach or a moving floating causeway.
- The ramp performs as the bow of the boat when stowed, both hydrodynamically (which greatly influences the position of the hinge point in association with the hull) and structurally.
- The ramp does not interfere with sightlines when stowed.
- Deployment times (and the supporting control system) allow for rapid deployment and recovery.

CAIMEN® Large Landing Craft and Ships

Developed for the movement of larger payloads, the monohull CAIMEN® series is designed to deliver heavier rolling and cargo payloads directly to a beach, hard standing or port, with the capability for international voyages or open sea conditions. Arranged with a large either open or enclosed cargo deck, the vessels are configured for the delivery of amphibious operations, tactical movement of military vehicles, general logistics, resupply and Humanitarian operations.

The designs feature a full length cargo deck enabling vehicle roll-on roll-off via stern and bow loading / unloading. The vessels hullform is designed to allow beaching for cargo off-loading via the bow with a minimal fording depth, typically 1m or less. The design typically would feature a bow visor enclosing a bi-folding ramp. Ramp length, beach performance and beaching payload would be assessed to suit the requirements.

The hullform has been developed to provide stability and robustness during beaching operations, whilst still offering an efficient hullform with good seaworthiness characteristics.

The presented designs illustrate solutions with vehicle deck space between 340m^2 to 950m^2 which is provided as 2 or 4 vehicle lanes width according to size. Typical cargo payloads would range from 200 tonnes through to 1000 tonnes with individual loads considered up to 60 tonnes although heavier vehicles (e.g. main battle tanks) can be accommodated depending on ramp equipment choice.

The vehicle deck is open to allow direct loading from alongside a pier to the cargo deck, although larger designs can be enclosed. A deck crane is provided for self loading and unloading and can also be used to launch boats stowed on the vehicle deck, enhancing the utility of the vessel. Deck stations are provided for vehicle fuelling, vehicle washing and power for stowed containers can be provided.

Troop accommodation can be provided for extended embarkation. Crew accommodation is provided in the superstructure and includes a central galley, dining and recreational spaces. Mass Evacuation Systems are provided for regulatory compliance and larger designs accommodate a dedicated ships boat.

The design uses all steel robust construction which can be in accordance with classification society rules (such as Lloyds Register or ABS), is compliant to MARPOL 73/78 Annexes I, IV, V and VI (Tier II), IMO Fire Safety, Water Ballast Management and SOLAS regulations. Propulsion features twin shafts with two propulsion diesel engines driving through reduction gearboxes, two diesel generators provide electrical power; tailoring for redundant power and propulsion notations and separate engine rooms is available for variants of the design.

The vessel is designed for a service speed of up to 15 knots and a range of between 2000 to 3500nm is available depending on vessel size. Endurance of up to 20 days for the crew and embarked troops.

Specific designs tailored to user requirements may be generated from the examples illustrated.

CAIMEN® Large Landing Craft and Ships continued

	Caimen 500	Caimen 1000	Caimen 1700
Length	75m	95m	115m
Beam	11.2m	14.2m	17.0m
Displacement, fully loaded	1400 tonnes	2800 tonnes	4700 tonnes
Draught, fully loaded	2.0m	2.6m	3.0m
Cargo payload in beaching condition	200 tonnes	500 tonnes	750 tonnes
Vehicle deck area	340m^2	580m^2	950m^2
Accommodation	18 Crew	30 Crew 30 Troops	40 Crew 75 Troops
Typical Range	2,000nm	2,750nm	3,500nm

CAIMEN® Large landing ship.

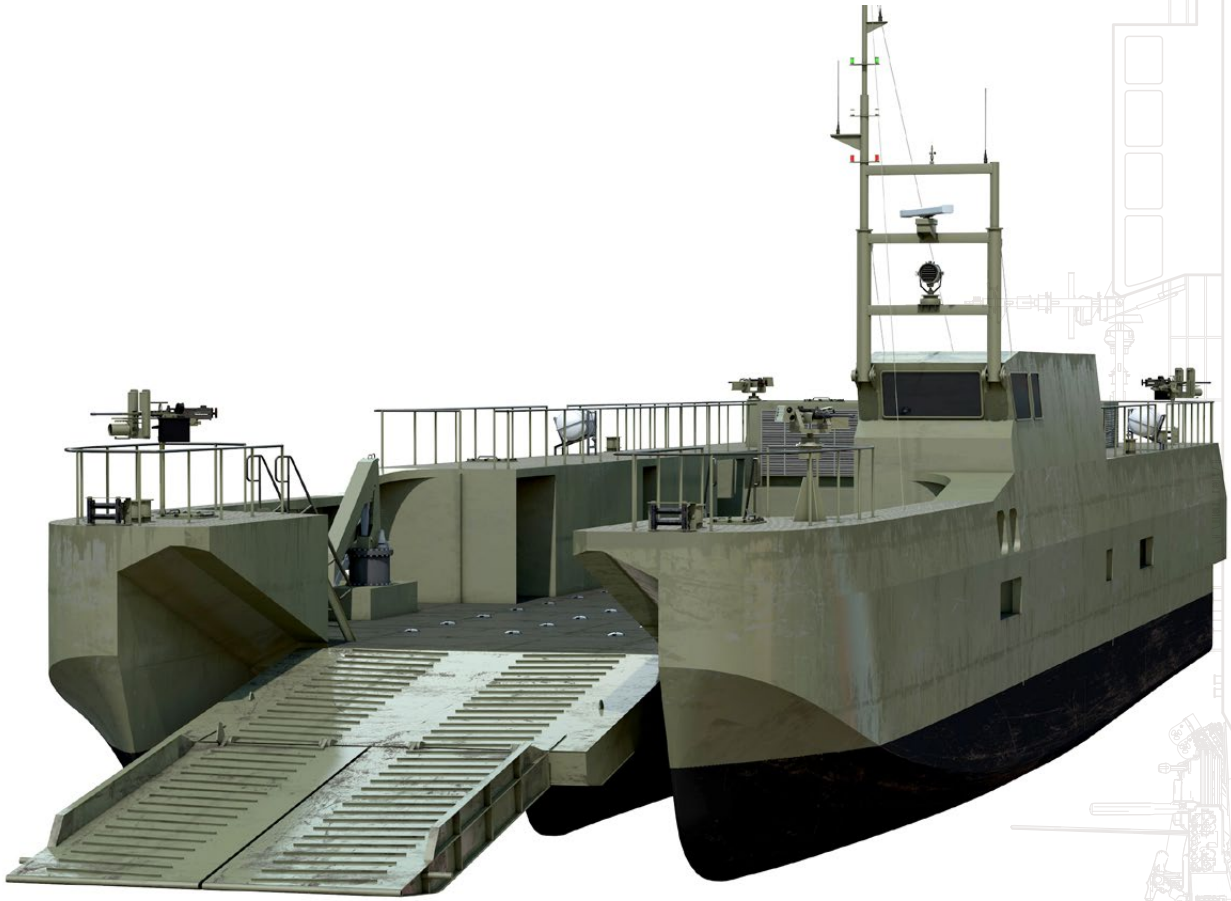
Bespoke CAIMEN® Solutions

Although this range describes a potential breadth of capability on offer, BMT provides customisable solutions that can be adapted to suit the requirements of military and security forces internationally, and BMT has already developed several bespoke CAIMEN® variant designs for specific Government customers.

In these cases CAIMEN® has been selected based on detailed studies of the unique needs of the amphibious forces in each case, coupled with the various design options available to fulfil those needs. CAIMEN® provides the optimal combination of performance, operational flexibility, reliability, and versatility, evolved into bespoke CAIMEN® solutions to meet aspects such as the following:

- Alternative materials (aluminium, steel, or steel/aluminium combinations)
- Varying range requirements, including extremely high range options
- Specific payload flexibility
- Enhanced accommodation for crew transit
- Platform geometry for aspects such as integration with mother ships or air draft
- Alternative ramp configurations
- Preferences for different machinery installations
- Design trade-offs for affordability

CAIMEN®-150



About BMT

BMT is the leading independent centre of engineering design, support and technical services for defence customers.

From concept design to acquisition support, in-service design and technology management, BMT is known for its innovation, expertise and ability to tackle the most complex design and systems issues.

BMT has a strong track record in naval platform design for surface warships, submarines and auxiliaries together with extensive acquisition support experience within land and maritime domain projects.

BMT employs over 700 specialists and support staff in defence and security markets. Its people include systems engineers, combat systems engineers, naval architects, marine engineers and software developers.

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defence-security@bmtglobal.com

www.bmt.org