

TITANIC: ALLEGATIONS & EVIDENCE

By Mark Chirnside

This article was first published in the *Titanic International Society's Voyage* 94 December 2015: Pages 55-60.

'Titanic faced disaster from the moment it set sail, experts now believe...Even if the ocean liner had not struck an iceberg during its maiden voyage, structural weaknesses made it vulnerable to any stormy sea'. (Copping, Jasper. *'Revealed: Titanic Was Doomed Before it Set Sail'*, *Daily Telegraph* 10 June 2007)

'Olympic...has, I think, proved to be a successful ship in the matter of strength'. (Principal Ship Surveyor to the Board of Trade, 1925)

An article in the last issue of *Voyage* (93) brought to mind a number of related claims which surfaced in newspapers and publications such as Brad Matsen's book *Titanic's Last Secrets* back in 2007 and 2008. One of the wackier ones by Jasper Copping is quoted above, but quite a few allegations were made to the effect that *Titanic* was not designed to be strong enough; that she sank because she broke up, rather than broke up as a result of her sinking; and that there was a conspiracy to correct these issues on her sister ships. These claims are particularly interesting because the validity of any assertion comes from the evidential basis to support it. In many cases, there appears to be no evidence to support them at all. Furthermore, claims such as these are at odds with what we do know from historical records.

It is beyond the scope of this article to address every aspect of all the individual claims, but to focus on a couple of the most significant ones and to discuss whether they stand up to scrutiny when compared with the evidence we have available.

EXPANSION JOINTS

Claim: The design of *Britannic's* expansion joints were changed as a result of *Titanic's* sinking.

Analysis: There is certainly a lot of misunderstanding about expansion joints and their role in the ship's design. While B-deck formed the top of the structural hull, the deckhouses at this level, A-deck and the boat deck above were comparatively lightly constructed and formed the

superstructure. The two expansion joints divided the superstructure into three separate sections so that they could move as the structural hull beneath flexed in a seaway. They protected the superstructure from the higher stresses that were borne by the structural hull beneath; stresses that the superstructure, which was essentially placed on top of it, was not intended or designed to bear.

The implication that *Titanic*'s expansion joints caused the ship to break up seems fairly widespread, but it is not true. They did not penetrate below the superstructure to the structural hull. The superstructure plating near an expansion joint would not be under tension stress: that would only be acting on the deck below, which formed the uppermost part of the hull girder. However, it would create a slight stress concentration point. Once the ship's hull was stressed to the point of failing then an initial failure has to begin somewhere. Therefore the areas in close proximity to the expansion joints would be more likely to experience failure, regardless of whether the ship broke initially from the top down or the bottom up. (It *does not follow* that the failure began there.)

Expansion joints were not a perfect solution. On board all large liners such as *Aquitania*, *Berengaria* and *Olympic* they did not prevent some localised stress fractures, for example at the corners of deckhouse windows adjacent to the expansion joints. (*Mauretania* had extensive stress fractures in the early 1920s and other large liners experienced it on a greater scale.) However, in general they did their job and, as one Board of Trade surveyor noted: 'it is practically impossible to prevent working [movement] in the plating of long superstructures of this nature and further [*sic*] the seaworthiness of the ship is not involved'. This is an important point. In fact, the superstructure could have been removed entirely and the structural hull beneath would retain its strength and integrity.

It is in this context that Harland & Wolff gained experience from *Olympic* in March 1912. On the bridge deck, B, there were a number of small fractures at the corners of rectangular windows in the long window screen near the expansion joints, while 'one very short fracture only was found in the houses on the promenade deck [A].' Fortunately 'neither the promenade deck or bridge deck plating nor the bulwark plating at the sides' were 'showing any signs.' There were also minor fractures at the base of the aft expansion joint on both sides of the ship. Although unsightly to anyone who inspected the plating closely, they did not represent a structural issue.

Nonetheless, a way to improve the design was to increase the number of expansion joints to enable greater flexibility, and this is what was done on *Britannic*. The 2006 expedition also discovered that the base shape of the forward expansion joint had been altered and widened to a ‘pear’ like shape: changes to the shape of the other expansion joints was not confirmed, but it seems likely that they would have been similarly altered. Changing the shape in this way would have made the plating less prone to minor cracking at corners. In light of experience with *Olympic* prior to the *Titanic* disaster, Harland & Wolff were already aware that the design could be improved; and, in the absence of any documentation that *Britannic*’s configuration was changed as a result of the loss of *Titanic*, the available evidence indicates it was simply one of many progressive changes made as they gained experience from an older sister ship and applied it to the next vessel in the class.

‘PANTING’ & *OLYMPIC* IN 1911

Claim: Thomas Andrews noticed *Olympic*’s hull panting in calm seas during the ship’s sea trials in May 1911 and recorded this in a design notebook. Pirrie then ordered Andrews to observe this on the ship’s maiden voyage in June 1911.¹

Analysis: Extensive enquiries with the relevant archives have indicated that no such notebook exists. Nor does there seem to be any record of Pirrie giving such an order.

What, precisely, is ‘panting’? As Edward Wilding explained: ‘When a ship is plunging into a big head sea there is a slight tendency on the part of the sides to go like a concertina, and that is known technically as panting’. These sea conditions did not exist on her trials.

We do know that other large liners of the period suffered from ‘panting’. An example is the German liner *Imperator*, which was the world’s largest liner in 1913-14 and was renamed after the war as Cunard’s *Berengaria*. As I wrote in *RMS Olympic: Titanic’s Sister* (revised and expanded edition 2015):

In January 1926, following ‘extremely rough weather’, [*Berengaria*’s] hull plating and frames were strained for about sixty feet from the bow, from H-deck towards the bottom of the ship. Modifications to strengthen her lower hull and prevent panting...had to be undertaken.

While other large liners of the period did suffer from panting and it was documented in official surveys, there is no reference or record whatsoever in official surveys that *Olympic* did.

OLYMPIC AND HULL CRACKS IN 1911

Claim: [In October 1911] ‘surveyors...found cracks on both sides of the ship where the plates of the main hull joined the plates of the bottom.’²

Analysis: There is no documentation or evidence at all to support the claims that any such damage was uncovered during the post-collision repairs in 1911.

We do know that the shipbuilder made some minor changes to *Titanic* (and subsequently *Olympic*) based on experience with *Olympic* in January 1912. This information was made available publicly for the first time when I wrote an online article on the subject for the Titanic Research & Modelling Association in 2005. These changes were summarised in *RMS Olympic: Titanic’s Sister* (revised and expanded edition 2015):

In January 1912, faced with one of the worst North Atlantic storms Captain Smith had experienced, [*Olympic*’s] number 1 hatch cover (weighing several tons) was ripped off and deck fittings damaged. Following observations during the crossing, Harland & Wolff had decided to fit a one-inch-thick steel ‘strap’ over the landings at the upper turn of the bilge, along the side of boiler room 6 and further ahead; and along the side of the turbine engine room and into the reciprocating engine room they did the same, drilling additional rivet holes to make it a quadruple-riveted joint. Her great length meant that the stresses at these points (about a quarter of her length ahead of the stern and abaft the bow) required some additional reinforcement beyond what previous experience had suggested was necessary, to prevent rivets in these areas becoming gradually slack in severe weather conditions.

These changes were intended to remedy what would have been a maintenance nuisance rather than a correction of any major weakness. In fact, similar design features such as additional riveting in these areas were then seen on vessels such as Cunard’s *Aquitania* and HAPAG’s *Bismarck* (White Star’s *Majestic* of 1922). Shipbuilders applied practical experience gained from ships in service to their previous theoretical knowledge.

At Christmas in 1905, White Star’s *Celtic* ‘was struck by a mighty wave’: ‘Portions of the great bulwarks were ripped off, and swept away, **fifty**

rivets, one and a half inches thick, being drawn out like carpet tacks’. An iron door, weighing four tons, was torn from its hinges, and ‘thirty feet of the promenade deck railing was smashed in’ according to a news report. Two years later, men at the Maritime Exchange in New York were discussing how water had got into *Mauretania*’s hold and damaged her cargo. Cunard officials said that they did not think ‘that the water had come in through straining of the plates or rivets’ and G. B. Hunter, chairman of Swan, Hunter, Wigham & Richardson, the ship’s builders, did not think it likely. He thought water had come through the ballast tanks. Pressed ‘if it was not possible that some of the rivets had become loosened by the strain of the heavy weather’, he replied ‘it was possible that several rivets might have worked loose’, asking: ‘What, are “several rivets” among four million?’ Unfortunately, it has not been possible to track down any survey reports to confirm the full details of these two particular incidents, but there is plenty of evidence of similar issues on other large vessels that makes it abundantly clear that rivets working loose and requiring caulking or replacement were not uncommon. Shortly after *Majestic* entered service in 1922, she required thousands of rivets caulking, and similar issues were reported in the case of *Empress of Britain* and *Aquitania*. The storm in January 1912 was one of the worst Captain Smith had seen in forty years and was probably the worst sea condition that a North Atlantic liner could have been expected to face. However, *Olympic* came through it and did not show any significant signs of weakness.

The changes were observed as part of the Board of Trade’s on going oversight and inspection process. We have the benefit of a very detailed report when *Olympic* was inspected in dry dock early in March 1912. Francis Carruthers inspected the structural hull specifically to see where repairs needed to be undertaken and whether there were any signs of undue stress. There were ‘about 160 rivets’ that were slack on the starboard side and needed drilling out and renewing; about ‘90 rivets were showing a little slack and were caulked’ on the port side; and about ‘100 rivets’ were found slack on each side aft, necessitating renewal. He concluded: **‘I carefully inspected the hull in the neighbourhood of these slack rivets but found no further signs of stress’.**

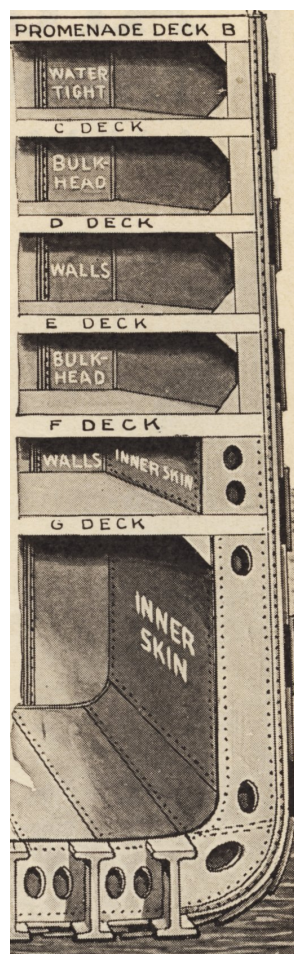
Matsen refers to the modifications to *Titanic* (and subsequently *Olympic*) as supporting evidence of the claim ‘that *Olympic*’s hull was cracking and had been reinforced’.³ It is not, and we know specifically from Francis Carruthers’ inspection above that he found ‘no further signs of stress’ such as cracking. Nor is there any evidence of any such problem in these areas during *Olympic*’s lengthy career. It turns out that ‘the discovery of cracks

in the forward section of *Olympic* in November [*recte*: October] 1911 is *deduced* [author's *emphasis*] from the location of the additional steel Andrews and Pirrie put into *Titanic*'.⁴ In truth, Edward Wilding appears to have overseen them and Thomas Andrews was certainly involved. Yet these minor design modifications were the specific result of storm conditions *Olympic* experienced in January 1912, as I outlined back in 2005.

There is no available evidence to support Matsen's claims. The evidence we do have available of a detailed inspection of *Olympic* in March 1912 is directly against it. Such modifications that were made to the two ships were a routine part of the shipbuilding and maintenance process and were reflected in subsequent liners. *Olympic* compares favourably with other large liners of the period in this respect and, as Edward Wilding said several years later:

'We have had less repairs to the *Olympic* than to any large ship we have ever built, due to external causes, of course'.

'PANTING' & THE INNER SKIN



Left: An illustration of *Olympic*'s new watertight inner skin, fitted during the 1912-13 refit and running the length of the boiler and engine rooms. The White Star Line used in promotional material to reassure the travelling public. (*Harper's Magazine*, 1913/Author's collection)

Following page: The full advertisement, describing her as 'virtually two ships in one'. (*Harper's Magazine*, 1913/Author's collection)

HARPER'S MAGAZINE ADVERTISER.

**THE
WHITE
STAR
LINE**

**NEW YORK
PLYMOUTH
CHERBOURG
SOUTHAMPTON**



THE NEW "OLYMPIC"
VIRTUALLY "TWO SHIPS IN ONE"

PROMENADE DECK B

C DECK

D DECK

E DECK

F DECK

G DECK

WATER TIGHT

BULK HEAD

WALLS

BULK HEAD

WALLS

INNER SKIN

Fitted with

DOUBLE SIDES
as well as
DOUBLE BOTTOM

WATERTIGHT BULKHEADS
extending from the
BOTTOM
TO THE TOP OF THE HULL

THUS AUGMENTING THE
FLOTATION CAPACITY
and enhancing
TO THE UTMOST

THE SAFETY OF THE VESSEL

The New "Olympic" is the greatest production of the premier British shipbuilders — the highest achievement of their long and fruitful experience in constructing many of the largest steamers of recent years—and in her, will be embodied everything that human foresight has devised for the safety of the passengers and crew.

Sailing from
NEW YORK **April 12, May 3**
MAY 24. JUNE 14. JULY 5.
and regularly thereafter.

White Star Line, 9 Broadway, New York.
Offices and Agencies Everywhere

PROMENADE DECK B

C DECK

D DECK

E DECK

F DECK

G DECK

WATER TIGHT

BULK HEAD

WALLS

BULK HEAD

WALLS

INNER SKIN

DOUBLE BOTTOM

When writing to advertisers kindly mention Harper's Magazine.

Claim: ‘The subsequent fitting of *Olympic* and *Britannic* with full [sic] double hulls was not for protection from puncture by icebergs, but to stiffen the ship. Wilding and Pirrie were not at all sure that *Titanic*, as built, had been strong enough...’⁵

Analysis: Officials from Harland & Wolff (Edward Wilding) and the White Star Line (Harold Sanderson) said publicly *and privately* that the inner skin was intended to enhance *Olympic* and *Britannic*’s watertight subdivision. In the absence of documentation to the contrary, we can look at the structural design of the inner skin and analyse it.

The basic contrast is that, if the purpose of the inner skin was to strengthen the ship’s hull, the inner skin structure would need to be connected very strongly to the existing outer hull in order to provide that additional strength. However, that would create a problem from the point of view of watertight protection. Put simply, if the outer hull plating was pushed in and pierced in collision, then the danger is that it would simply push in the inner skin plating too and compromise the watertight protection it provided.

When the claim arose back in 2007, I sought Scott Andrews’ opinion about the inner skin’s structural design, based on plans of the structure that Craig Mestach kindly showed to us. He advised:

I am of the opinion that the addition of the inner skin would have had **very little or no effect whatsoever in preventing panting of the ship’s sides**...there were very few connections made between the frames of the shell and the frames of the inner skin. These would have obviously been at the watertight bulkheads and at the watertight divisions of the voids between watertight bulkheads. The existing deep web frames, which were already connected to the shell frames and already very heavily stiffened by double angle face bars and tied to the side keelsons (stringers) by full or half-diamond gussets, though also attached to the inner skin, would have received very little additional reinforcement from the .44 to .56 inch plates of the inner skin. In short, for most of its length, the inner skin was a free-standing structure inboard of the shell plates that was only rigidly connected to the fabric of the hull at the Tank Top, the underside of F Deck, and at the side keelsons. There was **only occasional vertical transverse connection to the shell plating in areas that were already more than sufficiently strong to resist panting**, both due to the heavy nature of scantling of the frames and plates, and because of the heavy beams and knees connecting one side of the shell to the other.

We discussed it again some years later. Scott confirmed his earlier opinion and also remarked that the watertight subdivisions within the inner skin were:

formed by the already-existing solid-plate deep web frames fitted throughout the machinery and boiler spaces – all of the strength provided by these webs was already there in 1911, as were the intercostal stringer plates...that formed the tops of these voids. All that was required to make these existing features part of the double skin was to caulk them watertight. The added intermediate frames of the double skin were required to add stiffness to the double skin, and not the hull – they were not even as heavily attached to the main frames of the hull as were the knees of the deck beams!

Edward Wilding was asked at the Limitation of Liability Hearings in 1915:

Q. And the only thing necessary to have put an inner skin into the *Titanic* you have found by practical experience with the *Olympic*, was merely an extension of the plan upon which she was originally built?

- Yes.

Q. Which includes merely putting in plates and the strengthening of the structural parts?

- It was **not strengthening them, but modifying them.**

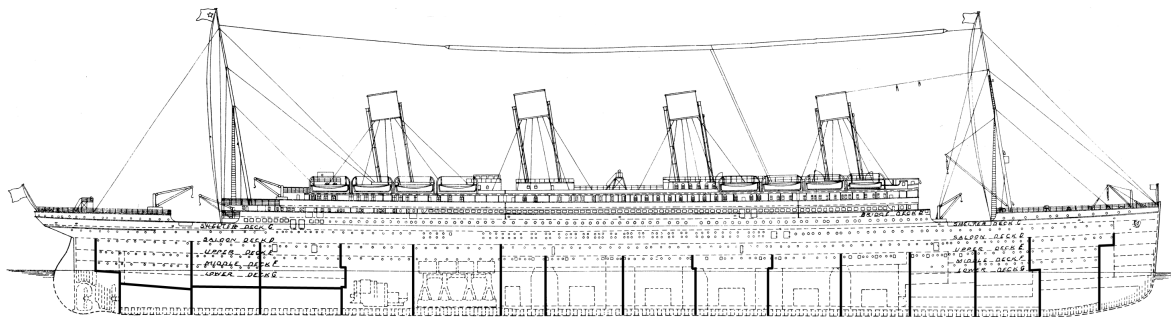
Wilding specifically denied that the relevant parts of the structure had been strengthened.

It is not always appreciated that, in the summer of 1912, thoughts were already turning to converting *Olympic* to oil fuel in the future and we know J. Bruce Ismay and Lord Pirrie were discussing the issue. She was a new ship and had a lengthy career ahead of her. When she was converted to oil in 1919-20, the inner skin was used to store oil fuel, and Harland & Wolff had borne this in mind in designing the inner skin.

It was difficult to provide additional longitudinal watertight protection in an existing ship. The boiler and machinery layout was already established and impossible to change, although the middle boiler in boiler room 5 was reduced in size on *Olympic* to help make way for the inner skin (*Britannic* was wider so it was not an issue). Nonetheless, the inner skin served its purpose. In September 1918, a torpedo slammed into *Olympic*'s port side amidships and pierced the outer hull. It failed to explode, but the resultant damage caused several sections of the inner skin to flood. The damage

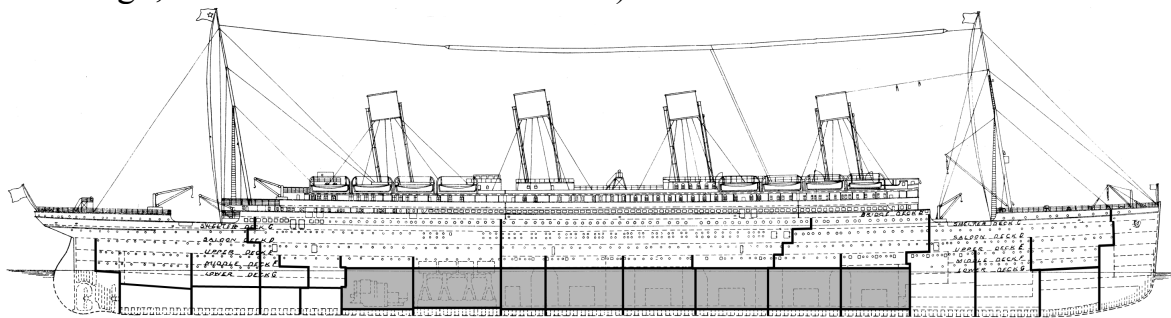
was undetected until she was seen in dry dock in February 1919, because the inner skin protected the boiler rooms from flooding.

Officials from Harland & Wolff and the White Star Line said publicly and privately that the purpose of the new inner skin was to improve the ships' watertight subdivision; the structural design of the inner skin supports this; and the practical experience of *Olympic's* encounter with a German torpedo in September 1918 demonstrates clearly the value of the inner skin in cases where the outer plating had been pierced.



Above: *Olympic's* watertight subdivision in 1911 – the same as *Titanic's*. (Bruce Beveridge, © 2010/Author's collection)

Below: After the 1912-13 refit, *Olympic* had seen considerable changes: additional watertight protection had been fitted in the forward hold; the extent of the inner skin is shaded in grey amidships; five watertight bulkheads extended up as far as the underside of the bridge deck, B; three watertight bulkheads aft had been lowered in height; and an additional watertight bulkhead fitted dividing the electric engine room. (Bruce Beveridge, © 2010/Author's collection)



THE A-DECK PROMENADE ENCLOSURE

Claim: That *Titanic's* A-deck promenade was enclosed at the fore end by a new screen in order to strengthen the ship: 'The enclosed promenade allowed for the addition of another café, but most importantly, it strengthened *Titanic* where *Olympic* was cracking. The added steel stiffened the front of the ship....'⁶

Analysis: The new Café Parisien was installed on B-deck aft, not A-deck forward. As we have seen above, the promenade deck was part of the ship's superstructure. It was not part of the structural hull and did not contribute to the strength of the structural hull. We come back to the issue that there is no available evidence that the ship needed strengthening. Furthermore, the new screen that was added to A-deck contained very little in the way of additional steel: it was relatively thin plating and pierced throughout by large windows, where the metal had been cut away. It was in precisely the same sort of screen where minor stress fractures at the corners of windows had been observed near expansion joints in *Olympic*'s B-deck. From a construction point of view, the idea that this thin screen would have strengthened the ship is nonsensical. Technical experts such as Scott Andrews and Bill Sauder have expressed the same view publicly.

HULL PLATING THICKNESS

Claim: That the general hull plate thickness of *Olympic* and *Titanic* was reduced at the request of J. Bruce Ismay, after the ship's plans were reviewed at the end of July 1908. The implication appears to be that the plating was then too thin: 'Ismay asked Andrews if the ships would be strong enough with the 1 inch plating...instead of the thicker plating and rivets in Andrews' specification tables...Andrews knew that if an owner wanted his ship made out of papier-mâché and the Board of Trade approved the specifications, the owner would get a papier-mâché ship. Andrews had no choice but to agree'.⁷

Analysis: Unlike Cunard, which had its own in house naval architect to design its ships and then direct the chosen shipyard to construct them in line with its own specifications, White Star relied on Harland & Wolff's design team. By 29 June 1908, the shipbuilder had already prepared a midsection plan. A plan of this sort was, essentially, a 'cutaway' showing all the structural elements of the ship's hull, from the double bottom plating, to the side plating, the pillars that supported the decks, the deck beams, and the heavy side and deck plating that formed the top of the hull girder. Other details included specification of triple and quadruple riveted joints, plus areas of the ship that were to be hydraulically riveted for additional strength where it was needed. It is clear from this plan that the hull plating at the side of the ship was already proposed as 1 inch thick in general, excepting areas where the plates were doubled for additional strength or where the hull narrowed towards the bow and stern.

At the end of July 1908, the White Star Line's own directors had given their approval to the basic 'Design "D"' concept shown to them by the

shipbuilder, but this was *a month after the shipbuilder had already completed a midsection plan showing the ship's hull plating was 1 inch thick*. How, then, could Ismay have ever requested in July 1908 that the ship's plating be reduced to 1 inch? The plating thickness shown on the 29 June 1908 plan was already the same as the final design for the completed ship.

A ship's hull is a complex structure. Hull plating is merely one structural element of many. The plating varied in thickness throughout the hull. Generally speaking, it was one inch thick amidships, doubled for extra strength at areas such as the turn of the bilge and the bridge sheer strake. In some areas, the hull was several inches thick. We can also compare her to some other large vessels built around the same time:

Ship	Gross tonnage (approximate)	General thickness of hull plating amidships
<i>France</i> (launched 1910)	25,000	0.80
<i>Homeric</i> (ex. <i>Columbus</i> , launched 1913)	35,000	0.94
<i>Titanic</i> (launched 1911)	46,000	1.00
<i>Majestic</i> (ex. <i>Bismarck</i> , launched 1914)	56,000	1.02
<i>Lusitania</i> (launched 1906)	32,000	1.10
<i>Aquitania</i> (launched 1913)	45,000	1.10

Majestic's plating was, for all intents and purposes, the same: the slight difference between 1 and 1.02 inches appears to stem from the German use of the Metric system of measurement while the British used the Imperial system. A general plate thickness of 1.25 or 1.5 inches would have been exceptionally heavy for a large vessel of this type. The claim that *Titanic's* hull plating was too thin is demonstrably false.

Aquitania was very similar in size to *Titanic*. Even though Cunard erred very much on the side of caution, sometimes increasing one of her specifications over and above what their shipbuilders thought was needed, *Olympic's* structure (and plating generally) was only 'somewhat lighter' than *Aquitania's* in the words of Cunard's naval architect Leonard Peskett. Aspects of *Olympic's* structure were superior to the Cunarder's, and vice versa. All aspects of a ship's design may be prone to amendment or revision during the design process and this is certainly the case from examining *Aquitania's* design and construction process, but *Olympic's* design was very much in line with the highest standard of the time.

COMPARATIVE STRENGTH

We can use comparative data to compare *Titanic*'s overall strength with similar liners built at the same time. The stresses on the hull could be calculated by treating the ship's hull as if it were a beam or girder. Naval architects then calculated the tendency to bend ('bending moment'), taking into account the ship's displacement and length. They expressed the results in terms of the stresses in tons per square inch borne by the hull plating at the top of the structural hull (in *Titanic*'s case, the sheer strake plating along C-deck). Although there was far more to a design's strength than this single measure, a lower stress figure indicated a stronger vessel.

The general practise of the period was to keep the stresses to about 10 tons per square inch for ships constructed of mild steel:

Ship	Gross tonnage (approximate)	'Stress on the gunwale' in tons per square inch
<i>Aquitania</i> (launched 1913)	45,000	8.5
<i>Titanic</i> (launched 1911)	46,000	9.9
<i>Lusitania</i> (launched 1906)	32,000	10.1
<i>Berengaria</i> (ex. <i>Imperator</i> , launched 1912)	52,000	10.2

In other calculations, the stress borne by *Lusitania* was calculated at 11.4 tons. However, it is important to bear in mind that her designers incorporated the use of high tensile steel in her upper structure that could withstand a higher stress than mild steel. It appears that the figure of 10.1 tons, above, was on an assumption of mild steel to aid comparison. The figure for *Aquitania* may understate the stresses she experienced, as it was based on a slightly lower loading condition. Some older vessels such as HAPAG's *Deutschland* (1900) were, in fact, designed to a higher level of stress (10.6 tons).⁸

It is quite clear that *Titanic*'s design was very similar to her peers. The reality is that a number of different shipbuilders, in Ireland, Scotland and Germany, worked to a similar standard of strength. These ships were built to the highest British and German national standards and the requirements of different classification societies.

TITANIC'S BREAK UP

Titanic's hull failed in the final moments of the sinking. It is clear that the ship had a matter of minutes left on the surface in any case, but what does the fact that the hull did fail tell us? Does it imply that *Titanic* was not strong enough? The answer is a definite 'no'.

Jamestown Marine Services (JMS), based in Groton, Connecticut, undertook a detailed study as part of the History Channel's *Titanic's Achilles Heel* programme in 2007. The results were interesting and detailed, but the key conclusion was that in the sinking process *Titanic* was subjected to stresses about 2.3 times the worst that she would have experienced in the most severe North Atlantic conditions.⁹

SUMMARY

We have examined a few specific claims in this article and analysed whether they stand up to the available evidence. It seems clear that they do not. The burden of proof is always on someone putting a claim forward. If they have the evidence to support what they are saying, it should be considered. It is not incumbent on other researchers to disprove it. However, when that evidence is not available, then there seems no valid reason to give credence to it.

Many people will have read books such as *Titanic's Last Secrets*. It is likely to have reached a popular history readership far beyond many books on the subject. I am fortunate to have a signed copy through the kindness of the author. It tells an intriguing story, but it cannot be considered accurate history. When available documentation is cited in support of a claim despite showing the opposite, then believing claims that do not have available documentation to support them is even harder still.¹⁰

It seems fitting to look at the evidence of what experienced professionals believed at the time. Officials from Harland & Wolff and the British Board of Trade believed that *Olympic* had proven herself a strong ship, with fewer repairs than any other large vessel Harland & Wolff had built during her early years of service. She was also held up as a comparative example of a strong ship, when they were discussing options to strengthen another large liner of the period.

'We have had less repairs to the *Olympic* than to any large ship we have ever built, due to external causes, of course'. (Edward Wilding, discussing the ship's general strength and referring to her early years of service)

'*Olympic*...has, I think, proved to be a successful ship in the matter of strength'. (Principal Ship Surveyor to the Board of Trade, 1925)

'The vessel would [still...after proposed strengthening measures], however, be some 20 per cent weaker than *Olympic*'. (Official

discussing options for repairing and strengthening another large liner of the period in the mid 1920s)

Shipbuilding was very much a process of using practical experience over time to supplement theoretical knowledge. Harland & Wolff were a leading shipbuilder and continuously improved their ship designs. We can see this in all sorts of ways, such as the changes made to *Titanic*'s propellers in an effort to improve her performance over *Olympic*. There were, literally, hundreds of minor differences between the two ships and in their superstructures. It is important not to see these refinements as part of a conspiracy theory.

ACKNOWLEDGEMENTS & BIBLIOGRAPHY

I appreciate the assistance, expertise and advice of: Scott Andrews; Bruce Beveridge; Sam Halpern; Roy Mengot and Craig Mestach. I am grateful to Brent Holt for proof-reading an early draft.

Chirnside, Mark. '*Olympic and Titanic: Straps and Other Changes*'. 2005. Online article for the Titanic Research & Modelling Association. (Accessed October 2015).

Chirnside, Mark. '*Olympic*'s Expansion Joints'. *Titanic Commutator*; Volume 31 Number 178; Pages 84-86. (Available online at: http://www.markchirnside.co.uk/Olympic-Titanic_expansionjoints-achillesheel-myth.html)

Chirnside, Mark. 'Target *Olympic: Feuer!*' *Titanic Commutator*; Volume 32 Number 184; Pages 160-65. (Available online at: <http://www.markchirnside.co.uk/Olympic-torpedoattack-U53-1918.htm>)

Chirnside, Mark. Unpublished Manuscript. 2006-present.

Mengot, Roy. '*Titanic*'s Blueprints'. 2000. Online article for the Titanic Research & Modelling Association. (Accessed August 2015)

Robinson, Andrew. 'The Partial Enclosure of the *Titanic*'s A-deck Promenade'. *Atlantic Daily Bulletin*; Number 1 2000: Page 12.

¹ Matsen, Brad. *Titanic's Last Secrets*. Twelve; 2008. Pages 119 and 123.

² *Ibid.* Page 131.

³ *Ibid.* Page 295.

⁴ *Ibid.* Page 294.

⁵ *Ibid.* Page 304.

⁶ *Ibid.* Page 232.

⁷ *Ibid.* Page 104.

⁸ It is also interesting to note some figures produced in a modern analysis of *Titanic* and other large liners that were constructed in the late 1920s and 1930s. This compared the 'bottom bending stress' in tons per square inch, with results ranging from *Manhattan* 7.9 tons; *Titanic* 9.1 tons; *Conte di Savoia* 9.8 tons; *America* 9.9 tons; *Rex* 9.9 tons; *Normandie* 11.1 tons and *Europa* 12.1 tons. While *Europa* and *Normandie* were constructed of high tensile steel and could 'exploit the properties of their

steel for higher stresses than other ships', the authors concluded: '*Titanic* does not stand out among this group as a ship with a highly stressed hull.' She was one of the least stressed. (See Garzke, William H., & Woodward, John, *Titanic Ships: Titanic Disasters: An Analysis of Early White Star and Cunard Superliners*. The Society of Naval Architects and Marine Engineers; 2002. Page 468.)

⁹ Halpern, Sam, with Akers-Jordan, Cathy, Behe, George, Beveridge, Bruce, Chirnside, Mark, Fitch, Tad, Gittins, Dave, Hall, Steve, Mitcham, Lester J., Weeks, Captain Charles, and Wormstedt, Bill. *Report into the Loss of the SS Titanic: A Centennial Reappraisal*. The History Press; Page 122.

¹⁰ It is interesting to note that Tom McCluskie has stated publicly: 'I...am on record as frequently reporting the hulls of the "*Olympic*" class vessels were perfectly adequate for the anticipated service conditions. Harland and Wolff never designed or built a ship with defective materials or known weaknesses, why would they? Further why would any ship owner deliberately contract for a vessel they knew would be unserviceable and unreliable in operation? It simply doesn't make any logical sense.' See McCluskie, Tom. *Titanic Historical Society Message Board Post*. 4 November 2008. <http://www.titanichistoricalsociety.net/forum/viewtopic.php?f=102&t=56&p=213&hilit=strong%23p214%23p214#p214> (Accessed 26 October 2015).