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TESTING OF HALLIDAY AND BAILLIE LTD
HAND RAIL BRACKETS

AUCKLAND UNISERVICES LIMITED

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THE UNIVERSITY OF AUCKLAND

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In order to determine the strength of a number of models of hand rail brackets, produced by Halliday and Baillie Ltd, a number of brackets were tested to failure under vertical compressive loads.

The AS/NZS 1170.1:2002 (Structural Design Actions), requires that the top edge of a handrail support a concentrated load of 0.6kN positioned for the worst effect acting, inward, downward or outwards. ASTM standard E 985 -00 *"Standard Specification for Permanent Metal Railing Systems and Rails for Buildings"* requires the railing system to withstand a minimum concentrated load of 890N, either horizontally or vertically applied (or 1110N if the rail is used as a transfer rail), similarly for the International Building Code, IBC (2003), requires a handrail assembly to resist a single concentrated load of 200lb (0.89kN) in any direction along the top and have attachment devices and supporting structure to transfer this loading to appropriate structural elements.

Fig 1 Jig used to apply compression loading to a HB 520 bracket assembly.

In all these standard requirements the supporting load is related to a ***handrail system***. Whereas in this testing the strength of a single brackets is being determined. A railing system, would comprise at least two brackets, therefore it would seem plausible, that a single bracket should have to carry >0.3kN to pass the AS/NZS value of 0.6kN, or > 0.445kN to pass the requirements of ASTM standard or IBC code of 0.89kN for a system. Also in this stage of testing only vertical loading has been applied.

Test System:- Jigs were produced to hold the bracket in an Instron 5500 series load frame.
The brackets were supported as shown in Fig 1, mounted into wooden blocks, or the wooden block was removed and the brackets were fixed into a steel plate with either a HB502, HB512 or HB522 glass fixing kit (see Fig 2). The brackets were the loaded in compression until failure occurred at a loading rates from 5mm/min.

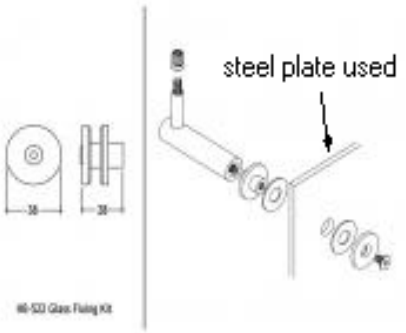


Fig 2 Glass mount kit

Load displacement curves are shown in Fig 3 for HB500 and HB510 Brackets. There is some scatter in the results, but some of this is likely due to the use of the wooden post, as the properties of each post will not be identical . However all the brackets failed well above 600N, required for a railing system under the AS/NZS, and well above the limits for a single bracket under the US codes.

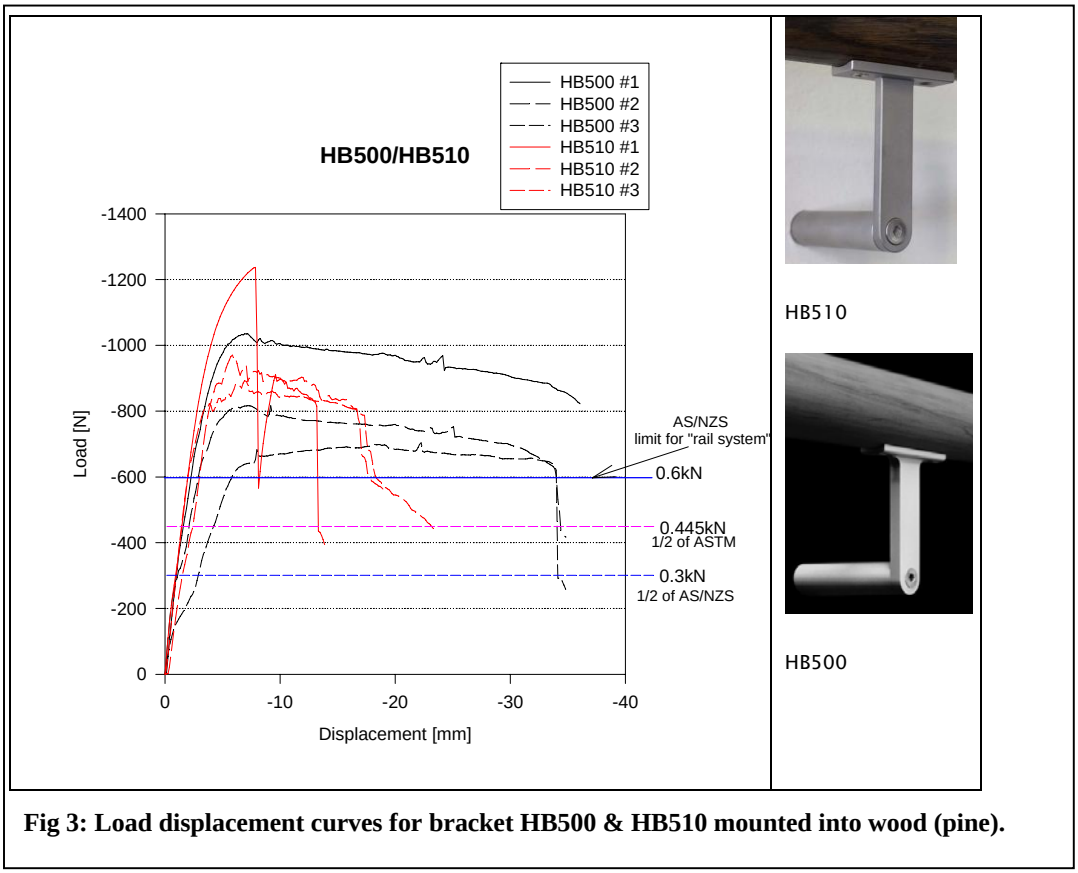
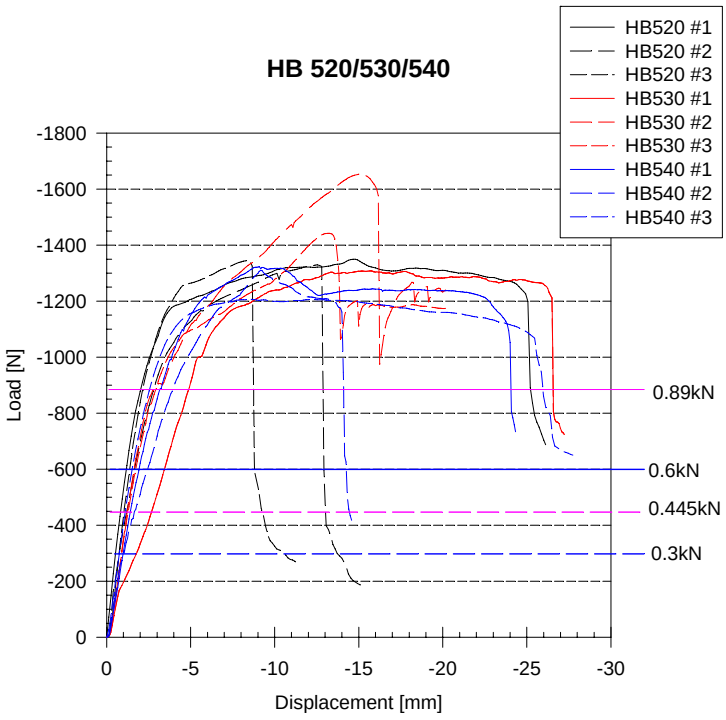


Fig 3: Load displacement curves for bracket HB500 & HB510 mounted into wood (pine).

All of the brackets showed a lot of deformation, more than 15mm before failing. In fact the flexibility of these brackets limited the maximum load that could be applied to the bracket with this setup. Fig 4 shows a HB500 Bracket under load.

Fig 4: HB500 Bracket under load (30mm deflection)

Fig 5 shows the load displacement data for brackets HB520, HB530 and HB540. All of these brackets perform similarly, most likely as they all use the same type of fixture to mount them to the wooden post. These brackets are all of stiffer design that the HB500 and HB510 series, as such the load supported is higher and the deformation is less on average. Of significance, all of these brackets support loads above 0.89kN those required for a “bracket system” under either, ASTM or IBC codes or the lower requirement of the AS/NZS 1170



HB 520

HB530

HB540

Fig 5 Load displacement curves for HB 520 HB530 and HB540 Brackets mounted into wood (pine).

Fig 6 shows the data after testing all the brackets mounted to a steel panel with the appropriate glass fix kit and gives a good indication of the bracket strength, without the influence of the wooden post. All the brackets show higher stiffness and well exceed the required load limits. *NOTE*: similar performance would not be expected while actually mounted into a typical glass panel.

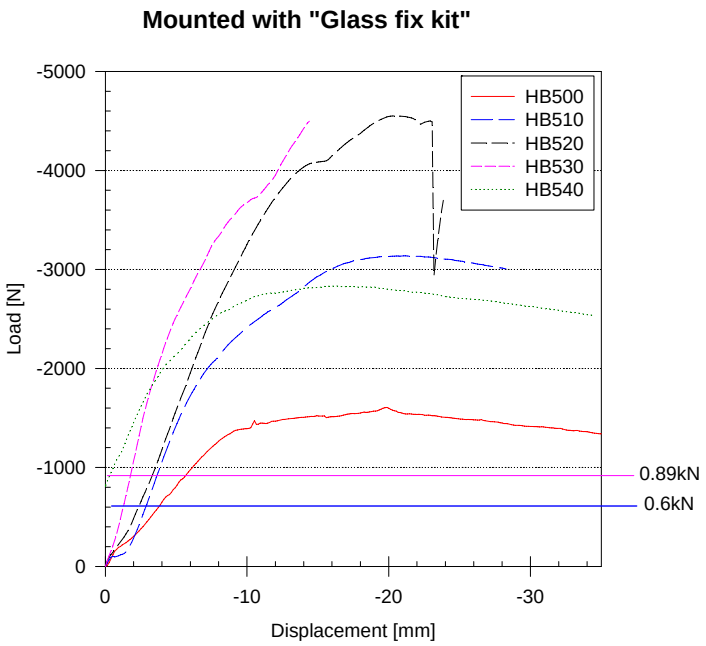


Fig 6: Brackets mounted to steel panel with glass fix kits

Conclusion: All of the Halliday and Baillie hand rail brackets tested complied with the vertical loading requirements of the various standards. Tests done on HB500 & HB510 brackets with a concentrated vertical load show that failure of the occurred with a lot of prior deformation and well above the 0.6kN requirement of AS/NZS 1170; which is therefore above the 445N, or half of the minimum load, of 890N required for a standard rail system (which comprises 2 or more brackets to provide support) under the ASTM or IBC codes. While the HB520, HB530 and HB540 brackets were much stiffer and all provided resistance to vertical loads greater than 890N. Similarly, the stiffer mounting provide by the glass fix kits allowed all the brackets tested to exceed the 890N vertical load requirement of the US codes. Loading in other orientations is to be confirmed.