8 Appendix A – Experimental results

8.1 Results of the tensile tests on the T-stubs

In the following, the detailed results obtained from the tensile tests performed on the T-stubs are reported. For each specimen the following data are collected:

- the displacement rate $\dot{\delta}$;
- the maximum load measured during the tests;
- the displacement measured by the three transducers A, B and C (according to Figure 33) associated with the maximum load;
- the observed collapse mode;
- some notes on the observed collapse and, if needed, on the instruments outputs or malfunctions;
- the force vs. displacement curves obtained from transducers measures for each specimen;
- the photographs of the specimen during the test and after the collapse has occurred;
- the bolts pretorque;
- the maximum axial deformation of the bolts measured using the strain gauges installed within each bolt (Figure 33);
- the maximum axial load acting in the bolts shank, calculated using the calibration curves previously obtained for each bolt (as reported in the main document);
- the force vs. bolt axial load and the force vs. bolt axial deformation curves obtained for each bolt;
- the photographs of each bolt after the collapse has occurred.



Figure 33: The instruments set-up

| Specimen C-01 | | | | | | | |
|---------------|--------|-----------------|------------------------------|------------------------------|------------------------------|--|--|
| | δ | Maximum load | Displacement transducer A | Displacement transducer B | Displacement transducer C | | |
| | [mm/s] | [kN] | [mm] | [mm] | [mm] | | |
| C-01 | 326,90 | 487,95 | 8,12 | 8,15 | 9,60 | | |

Collapse mode: mode 2 (tending to mode 3)

Note: collapse of bolt B followed by the collapse of bolt A 600 Force (kN) 500 400 300 -Transducer A 200 -Transducer B -Transducer C 100 Displacement (mm) 0 0 2 4 6 8 10 12 14 16 18 C-01 C-01



| Specimen C-02 | | | | | | | | |
|---------------|--------|-----------------|------------------------------|------------------------------|------------------------------|--|--|--|
| | δ | Maximum load | Displacement transducer A | Displacement transducer B | Displacement transducer C | | | |
| | [mm/s] | [kN] | [mm] | [mm] | [mm] | | | |
| C-02 | 326,90 | 502,99 | 9,66 | 0,02(*) | 11,44 | | | |

Collapse mode: mode 2 (tending to mode 3)

Note: contemporaneous collapse of both bolts

(*) measures of transducer B are not available



Specimen during the test



| Specimen C-03 | | | | | | | |
|---------------|--------|-----------------|------------------------------|------------------------------|------------------------------|--|--|
| | δ | Maximum load | Displacement transducer A | Displacement transducer B | Displacement transducer C | | |
| | [mm/s] | [kN] | [mm] | [mm] | [mm] | | |
| C-03 | 326,90 | 510,92 | 10,35 | 9,40 | 11,04 | | |





Bolt C-03 A after the collapse

Bolt C-03 B after the collapse

| | Specimen C-05 | | | | | | | | |
|------|---------------|-----------------|------------------------------|---------------------------|------------------------------|--|--|--|--|
| | δ | Maximum load | Displacement transducer A | Displacement transducer B | Displacement transducer C | | | | |
| | [mm/s] | [kN] | [mm] | [mm] | [mm] | | | | |
| C-05 | 0,07 | 458,42 | 13,54 | 11,84 | 14,68 | | | | |



C-05 C-05

Specimen during the test



| | | | Specimen C-06 | | |
|------|----------------|---|------------------------------|----------------------------|------------------------------|
| | δ | Maximum load | Displacement transducer A | Displacement transducer B | Displacement transducer C |
| | [mm/s] | [kN] | [mm] | [mm] | [mm] |
| C-06 | 0,07 | 441,19 | 12,56 | 8,33 | 7,06 |
| | | Collapse mo | de: mode 2 (more pr | onounced) | |
| | | No | te: collapse of bolt A | | |
| | 600 Force (kN) | | | | |
| | 500 | | | | |
| | 400 | | | | ` |
| | 300 | | | | |
| | 200 | | | —Transducer —Transducer | A B |
| | 100 | | | -Transducer | C |
| | | | | Displacemer | 1t (mm) |
| | 0 2 | 4 6 | 8 10 | 12 14 1 | 6 18 |
| | | OF TRENTO - Italy Faculty of Engineering | | C | 2-06 |
| (| C-06 | | | | |
| 1. | | | | | |



| Specimen C-07 | | | | | | |
|---------------|---------------------------|-----------------|------------------------------|------------------------------|------------------------------|--|
| | δ | Maximum Ioad | Displacement transducer A | Displacement transducer B | Displacement transducer C | |
| | [mm/s] |] [kN] | [mm] | [mm] | [mm] | |
| C-07 | 0,07 | 465,53 | 7,47 | 7,27 | 10,33 | |
| | | Collapse me | ode: mode 2 (tending | to mode 3) | | |
| | | N | ote: collapse of bolt B | | | |
| | ⁶⁰⁰ For | CE (kN) | | | | |
| | 500 | | | | | |
| | | | A | | | |
| | 400 | | | | | |
| | 300 | | | | | |
| | | | | | | |
| | 200 | | | —Transducer A | A | |
| | 200 | | | | 5 | |
| | | | | | , , | |
| | 100 | | | | | |



Specimen after the collapse

Displacement (mm)



| | Specimen C-08 | | | | | | | |
|------|---------------|-----------------|------------------------------|---------------------------|------------------------------|--|--|--|
| | δ | Maximum load | Displacement transducer A | Displacement transducer B | Displacement transducer C | | | |
| | [mm/s] | [kN] | [mm] | [mm] | [mm] | | | |
| C-08 | 160,00 | 445,35 | 8,05 | 6,84 | 6,74 | | | |

Collapse mode: mode 2 (tending to mode 3)

Note: contemporaneous collapse of both bolts





Bolt C-08 A after the collapse

Bolt C-08 B after the collapse

| | Specimen C-09 | | | | | | | |
|------|---------------|-----------------|------------------------------|------------------------------|------------------------------|--|--|--|
| | δ | Maximum load | Displacement transducer A | Displacement transducer B | Displacement transducer C | | | |
| | [mm/s] | [kN] | [mm] | [mm] | [mm] | | | |
| C-09 | 160,00 | 487,30 | 6,88 | 6,82 | 8,52 | | | |

Collapse mode: mode 2 (tending markedly to mode 3)

Note: contemporaneous collapse of both bolts



Specimen during the test

Specimen after the collapse



Bolt C-09 A after the collapse

Bolt C-09 B after the collapse

| | Specimen C-10 | | | | | | | | |
|------|---------------|-----------------|------------------------------|---------------------------|------------------------------|--|--|--|--|
| | δ | Maximum load | Displacement transducer A | Displacement transducer B | Displacement transducer C | | | | |
| | [mm/s] | [kN] | [mm] | [mm] | [mm] | | | | |
| C-10 | 160,00 | 479,81 | 6,30 | 6,61 | 8,98 | | | | |

Collapse mode: mode 2 (tending to mode 3)



