Organization of the dataset

This report is an auxiliary document to the dataset. If using the data please cite:

A. Rosso, L.A. Jimenez-Roa, J.P. Almeida, A.P. Guerrero Zuniga, C.A. Blandon, R.L. Bonett and K. Beyer. **Cyclic tensile-compressive tests of thin concrete boundary elements with a single layer of reinforcement prone to out-of-plane instability**. *Submitted to Bulletin of Earthquake Engineering*, 2017.

The paper describes an experimental campaign consisting of 12 thin reinforced concrete (RC) boundary elements tested under cyclic axial tensile-compressive loading. The details that could not be included in the main paper due to space limitations, and that are required for a complete description of the dataset, are addressed herein.

Instrumentation

Hard-wired Measurements

During the test, 12 hard-wired measurements were recorded with a frequency of 2 Hz and five channels were computed from these measured channels. A summary of recorded and computed channels is described in section Organization of the data. In the following, it will be referred to cardinal points according to Fig. 1.

Four linear variable displacement transducers (LVDTs) were placed at the four corners of the column (Fig. 2a). The labelling of the instruments was based on their position with respect to the cardinal points shown in Fig. 1. Three out of four LVDTs are shown in Fig. 2b (LVDT_NW, LVST_NE and LVDT_SW). The average of the four LVDTs was used for applying the target displacements. A further LVDT was placed on the piston of the testing machine, see Fig. 2b. In the first four tests (TC09 to TC12) also two laser LVDTs (also visible in Fig. 2b) were placed at the base of the testing machine (Laser_N and Laser_S) at a distance of 500 mm from each other, to check the rotation of the piston plates which had to be null.

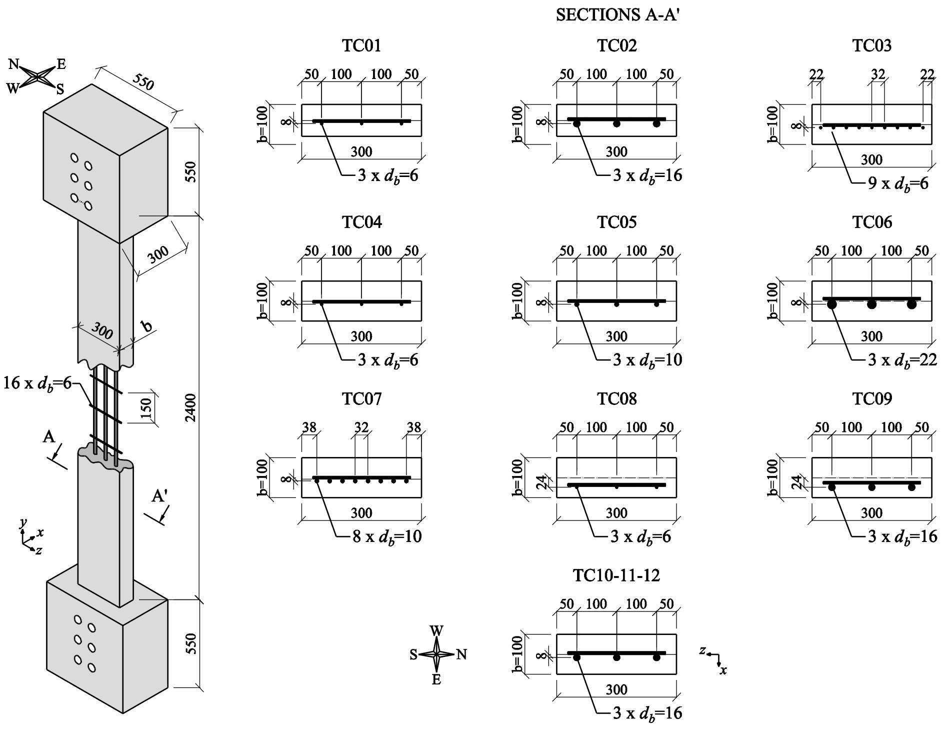

Fig. 1 Spatial representation of TC10-11-12 and cross-section of all tested specimens (dimensions in mm).

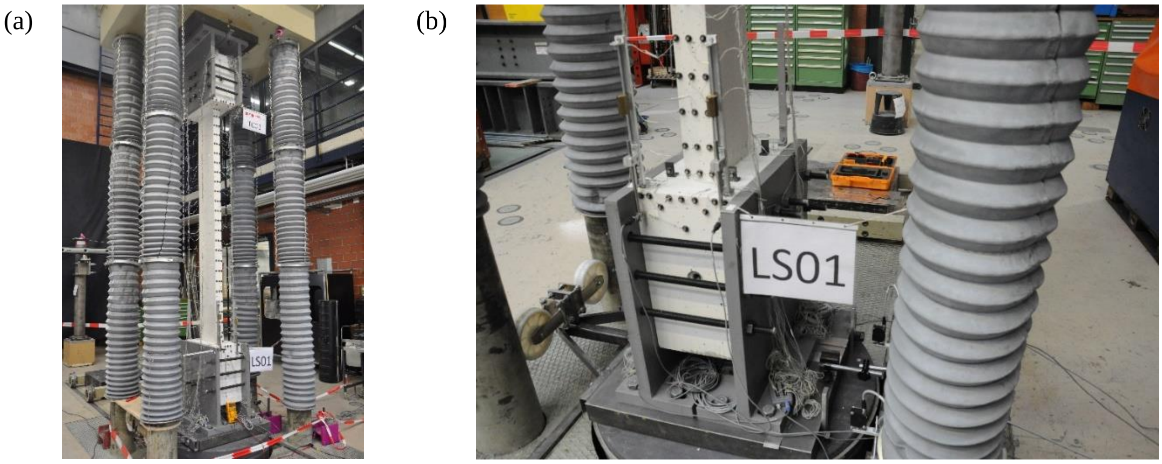

Fig. 2 a Spatial view of the test setup; b Detail of the LVDTs used in the test.

Optical Triangulation Measurements

The 3D displacements of the North and South surfaces were measured using the optical measurement system NDI Optotrak Certus HD (NDI, 2009), using a total of 186 markers. On the column surfaces, each row was formed by three LEDs—placed along the thickness, 10 mm from the edges and at the centreline of the column—at a vertical row spacing of 100 mm (see Fig. 2a). Further markers were placed on the concrete blocks and on the steel profiles. The numbering of LEDs after post-processing is shown in Fig. 3a-b.

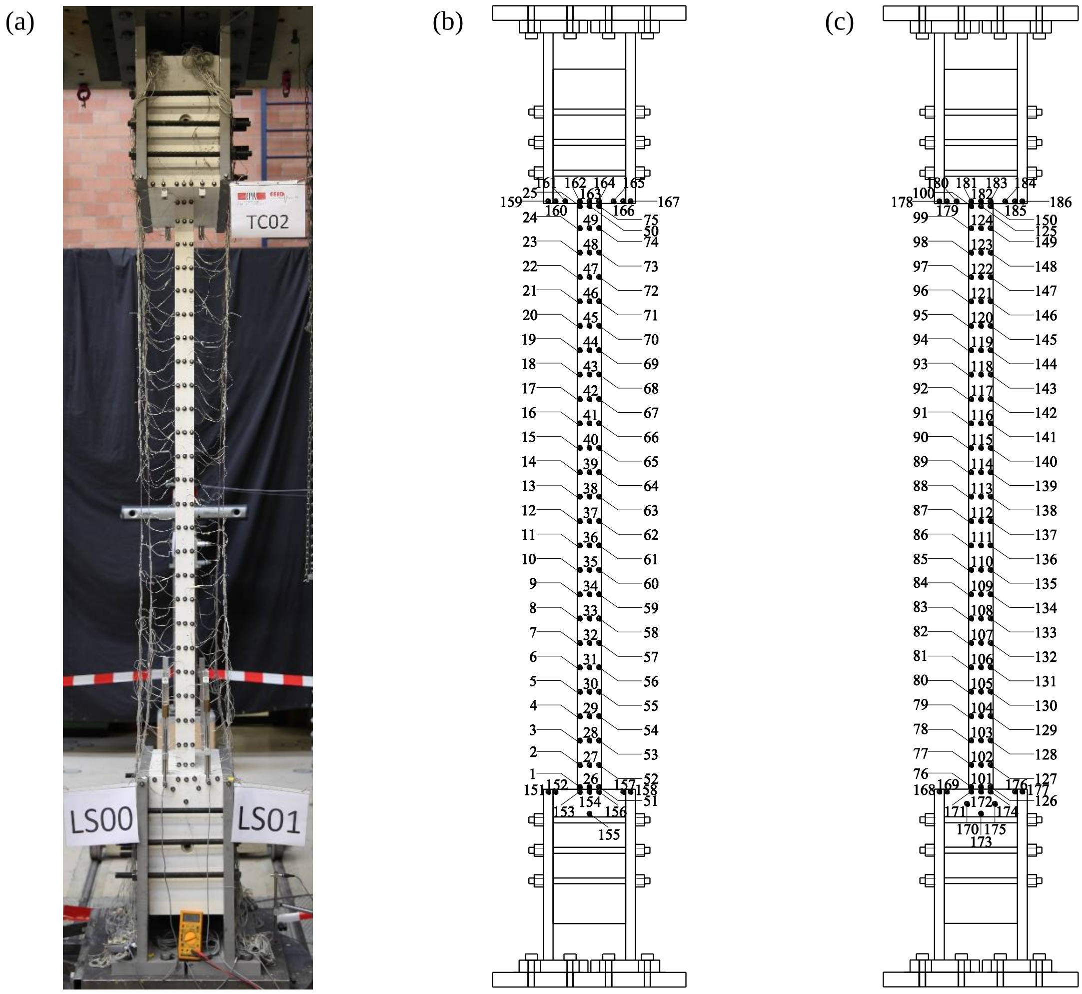

Fig. 3 a View of the LEDs grid (North side); Numbering of LEDs after post-processing: b South side; c North side.

Organization of the data

All test data can be downloaded from a publically accessible platform Zenodo, at DOI 10.5281/zenodo.569799. The structure of the data folders is summarized in Fig. 4. The data is organized by specimen, with specific folders for each test unit “TC(i)”.

“TC(i)” folders

The data is organized first by specimen. In Fig. 4 the folder for a generic column TC(i) is represented, and the latter is additionally divided into four sub-folders:

1. “Material Tests”: two sub-folders contain the results of the material tests performed on the “Concrete” (compression tests) and on the “Reinforcement” (uniaxial tensile tests).

2. “Experimental Level”: a copy of the laboratory notebook, which records observations made during the experimental test, is provided in the form of an Excel spreadsheet (named “TC(i)_Lab_Book.xls”). Two main sub-folders, “Photos” and “Videos”, are part of this sub-level. The former collects several photos of the test: images of the entire column and of interesting details of the specimen (taken in-between two or at the load stages respectively) are provided. The second collects the videos of the cycle from tension to compression in which the largest out-of-plane deformation was attained (“TC(i)_1.mts”), and of the one in which failure occurred (“TC(i)_2.mts”). Note that the videos were recorded from the North side of the column.

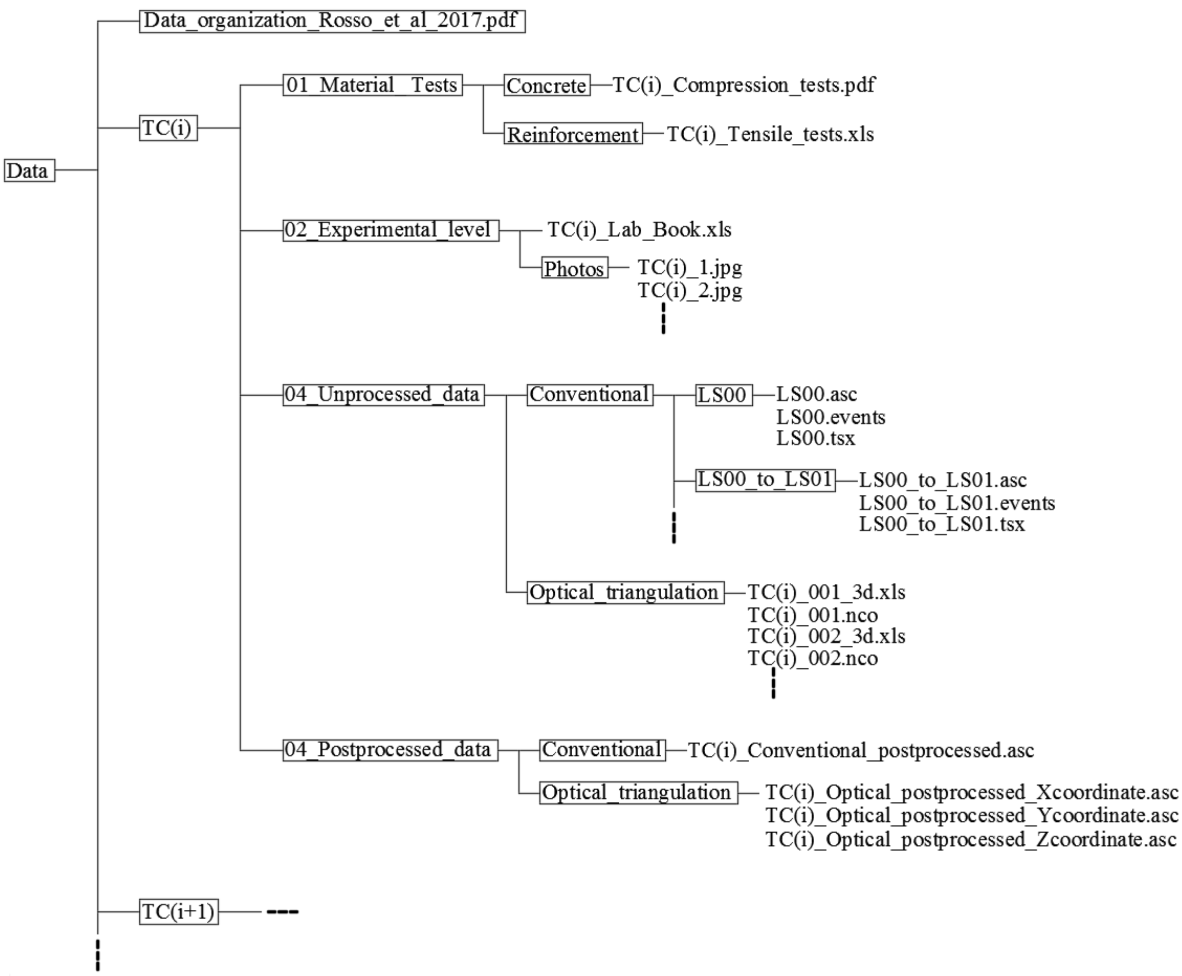

Fig. 4 Data organization for a generic column TC(i).

3. “Unprocessed Data”: This folder contains the original recordings from the conventional and optical measurement systems. In the “Conventional” folder the original output files of the system *CATMAN* (HBM, 2000), used to record the conventional measurements (see Tab. 1), are collected. In the folder “Optical triangulation” the outputs from the LED measurement system are collected.

4. “Post-processed Data”: the optical triangulation data was post-processed in order to synchronize the conventional and the optical measurement systems to reduce the amount of data, and to remove any bias or data that is not linked to the actual behaviour of the test unit (e.g. data was removed when a LED fell off). The data is again divided in two folders: “Conventional” and “Optical”.

“Conventional” folders

During the test, a total of 12 channels have been recorded and five channels were computed from these recorded channels. A list of these channels is given in Tab. 1, and the corresponding data is provided in the “Conventional” folders within the “03_Unprocessed_data” folder. A brief description of these channels is given in the following:

- Channel 1: measured the recording time.
- Channels 2 to 7: recorded the displacements of the four LVDTs.
- Channels 6 and 18: recorded the displacement of the external LVDT placed on the piston and connected to the testing machine. Channel 6 recorded the values as read from the testing machine, while channel 18 was set to zero at the beginning of the test.
- Channel 7: indicates two distinct values to signal whether the LED measurement system was recording or not. A negative value indicated that the LED measurement system was not recording and a value of zero that it was recording. The conventional measurements were always started before and stopped after the optical measurements, and this voltage signal was used in post-processing phase to synchronize the two systems
- Channels 8 and 17: recorded the value of force measured by the internal load cell of the testing machine. Channel 8 recorded the values as read from the testing machine, while channel 17 was set to zero at the beginning of the test.
- Channels 9 and 10: corresponded to the laser-LVDTs placed at the base of the testing machine to check the base rotation. This instruments were used only during the first four tests (TC09 to TC12), therefore in the followings a constant displacement value is recorded within the test. After post-processing these channels were set to zero when the laser-LVDTs were not used.
- Channels 11 to 13: empty channels. After post-processing they have been removed.
- Channels 14 to 16, 19, 20: computed values that were used as live checks during the test.
  Channel 14 and 15 corresponded to the displacement and the strain calculated averaging the measurement of the four LVDTs, and they were used to control the deformations imposed during the test.
  Channel 16 could correspond to two different measures: (ii) to the displacement obtained averaging three LVDTs (used as check in case one LVDT had fallen or stop working) for specimens TC01 to TC08; (i) of the base torsional rotation of the testing machine for specimens TC09 to TC12.
  Channels 19 and 20 were the average stress and strain, as calculated using the measurements corresponding to the testing machine.

After post-processing, the conventional channels were reorganized following the order shown in Tab. 2. In case of special specimens (e.g., TC03 for which some modifications of the test setup were required, or TC09 who was inserted differently in the testing machine, or TC12 who was the pilot test) the data were adapted to be consistent to the other specimens and to the reference system shown in Fig. 1. The final data is provided in the “Conventional” folders within the “04_Postprocessed_data” one, and each channel corresponds to the relative column of the file “TC(i)_Conventional_postprocessed.asc”.

Tab. 1 Channels recorded during the test.

Ch.	Ch. Info	Name of instrument	Type of instrument	Range	Set to zero	Notes
1	Measured	Time	CATMAN recording	Hz	-	-
2	Measured	LVDT_NW	LVDT	±50 mm	Yes	-
3	Measured	LVDT_SW	LVDT	±50 mm	Yes	-
4	Measured	LVDT_NE	LVDT	±80 mm	Yes	-
5	Measured	LVDT_SE	LVDT	±80 mm	Yes	-
6	Measured	Displ_TREBEL	Testing machine LVDT	±80 mm	No	-
7	Measured	LEDs	Optical measurement	-	-	-
8	Measured	Load TREBEL	Testing machine load cell	±10 MN	No	-
9	Measured	Laser_N	Laser LVDT	±50 mm	Yes	
10	Measured	Laser_S	Laser LVDT	±50 mm	Yes	-
11	Empty	MGCplus_1 CH 5-6	-	-	-	-
12	Empty	MGCplus_1 CH 5-7	-	-	-	-
13	Empty	MGCplus_1 CH 5-8	-	-	-	-
14	Computed	Average displacement LVDTs	-	-	-	(LVDT_NW+LVDT_SW+LVDT_NE+LVDT_SE)/4
15	Computed	Average strain LVDTs	-	-	-	Average displacement LVDTs/2400
16[a]	Computed	Average 3 LVDTs	-	-	-	(LVDT_NW+LVDT_SW+LVDT_NE)/3
16[b]	Computed	Torsional Rotation at Trebel base	-	-	-	(Laser_S-Laser_N)/500
17	Measured	Load	Testing machine load cell	±10 MN	Yes	-
18	Measured	Displacement	Testing machine LVDT	±80 mm	Yes	-
19	Computed	Average stress	LVDT	-	-	Load/(100·300)
20	Computed	Average strain TREBEL	LVDT	-	-	Displacement/2400

[a]In the case of specimens TC01 to TC08. [b]In the case of specimens TC09 to TC12.

Tab. 2 Channels after postprocessing.

Ch.	Ch. Info	Name of instrument	Type of instrument	Range	Set to zero	Notes
1	Measured	Time	CATMAN recording	Hz	-	-
2	Measured	LVDT_NW	LVDT	±50 mm	Yes	-
3	Measured	LVDT_SW	LVDT	±50 mm	Yes	-
4	Measured	LVDT_NE	LVDT	±80 mm	Yes	-
5	Measured	LVDT_SE	LVDT	±80 mm	Yes	-
6	Measured	LEDs	Optical measurement	-	-	-
7	Measured	Load TREBEL	Testing machine load cell	±10 MN	No	-
8	Measured	Displ_TREBEL	Testing machine LVDT	±80 mm	No	-
9	Measured	Laser_N	Laser LVDT	±50 mm	Yes	
10	Measured	Laser_S	Laser LVDT	±50 mm	Yes	-
11	Computed	Average displacement LVDTs	-	-	-	(LVDT_NW+LVDT_SW+LVDT_NE+LVDT_SE)/4
12	Computed	Average strain LVDTs	-	-	-	Average displacement LVDTs/2400
13[a]	Computed	Average 3 LVDTs	-	-	-	(LVDT_NW+LVDT_SW+LVDT_NE)/3
13[b]	Computed	Torsional Rotation at Trebel base	-	-	-	(Laser_S-Laser_N)/500
14	Measured	Load	Testing machine load cell	±10 MN	Yes	-
15	Measured	Displacement	Testing machine LVDT	±80 mm	Yes	-
16	Computed	Average stress	LVDT	-	-	Load/(100·300)
17	Computed	Average strain TREBEL	LVDT	-	-	Displacement/2400

[a]In the case of specimens TC01 to TC08. [b]In the case of specimens TC09 to TC12.

The vertical displacement were imposed considering the average measurement of the four corner LVDTs, therefore for plotting the force-displacement curve it is advice to use the postprocessed channels 14 ('Load' initially set to zero) and 11 ('Average displacement LVDTs').

Note that often the tests were continued even after out-of-plane failure occurred. The data are provided also for this phase of the tests, although the results are no longer useful for the determination of the critical tensile strain triggering failure for out-of-plane instability.

"Optical_triangulation" folders

In the "Optical_tringulation" folder, within the "03_Unprocessed_data" one, the data of the optical measurement system is collected. The recording sequence of the raw data is provided in an Excel file (extension ".xls") and the sensor settings in the NDI-specific file formats (extension ".nco"). In each Excel spreadsheet, the actual measurements are organized in columns: the first column stores an index starting from 1, while the following columns give the coordinate measurements of the LEDs (each three columns store the x-, y-, and z-coordinate measurements of one LED respectively). Note that the LED numbers are at this stage still unorganized and the numbering indicated in these files does not correspond to the LED numbering of the processed data. If the LED-coordinates of a LED were not measured (because the LED was not visible or because it fell off during the test), the columns corresponding to such LED do not contain any entries. The origin of the reference system of the raw data is the center of the master sensor.

Within the "04_Postprocessed_data" the data has been reorganized and the numbering of the LEDs was modified according to Fig. 3b-c. In the files "TW(i)_Optical_postprocessed_(k)coordinate.asc", the first row indicates the LED number, while the following rows report the measured displacement along the (k) coordinate—x, y or z—during the test according to the reference system shown in Fig. 1.

References

HBM (2000) 'Catman Data acquisition Software'. Hottinger Baldwin Messtechnik GmbH, Darmstadt, Deutschland: http://www.hbm.com/en/menu/products/software/data-acquisition-software. Available at: http://www.hbm.com/en/menu/products/software/data-acquisition-software.

NDI (2009) 'Optotrak Certus HD, Northern Digital Inc.' Waterloo, Ontario, Canada: http://www.ndigital.com/industrial/certushd.php. Available at: http://www.ndigital.com/industrial/certushd.php.