UWS1 Specimen Description

This document summarizes the description of the design parameters of the first wall unit, UWS1.

GEOMETRY AND REINFORCEMENT LAYOUT

Test specimen UWS1 has a thickness (t_w) of 100 mm, with web and flange lengths (L_w and L_f) of 1300 mm and 1050 mm, respectively, as defined in Figure 1a. Differing from previous quasi-static units, these units for dynamic tests have two 100 mm thick intermediate slabs spaced 1.5 m apart, as illustrated in Figure 1b. Each slab measures 1900 mm x 1620 mm and is hollow inside the core wall. The slabs were reinforced with two layers of mesh of 6mm diameter, with a square spacing of 100 mm. The foundation block, measuring 2.1 m x 2.1 m as depicted in Figure 1b, was fastened to the shake table floor using sixteen M30 threaded bars evenly spaced at 500 mm intervals. Instead of a loading stub (or slab), a top collar (i.e., increased wall thickness at the head) was used, which is expected to only partially restrain warping. The dimensions of the top collar, as shown in Figure 1b, include a depth of 500 mm. The wall height from the top of the foundation to the centre of the wall collar is 4290 mm.

The design of the test units followed a similar approach to others. Rather than adhering to a specific code, the design aimed for high ductility using capacity design principles deemed reasonable. For instance, as shown in Figure 1a, the wall units were designed with boundary elements containing a higher concentration of longitudinal and transverse reinforcement to ensure the development of high compressive strains in these regions, necessary for a ductile wall response.

UWS1 was reinforced with 12 mm (Φ12) conventional steel according to Eurocode 8, as depicted on the left-hand side of Figure 1a. The flange boundary ends of UWS1, detailed with 6 × 12 mm steel rebars, have a vertical reinforcement ratio (ρ_{wv}) in the boundary ends of approximately 2.3%.

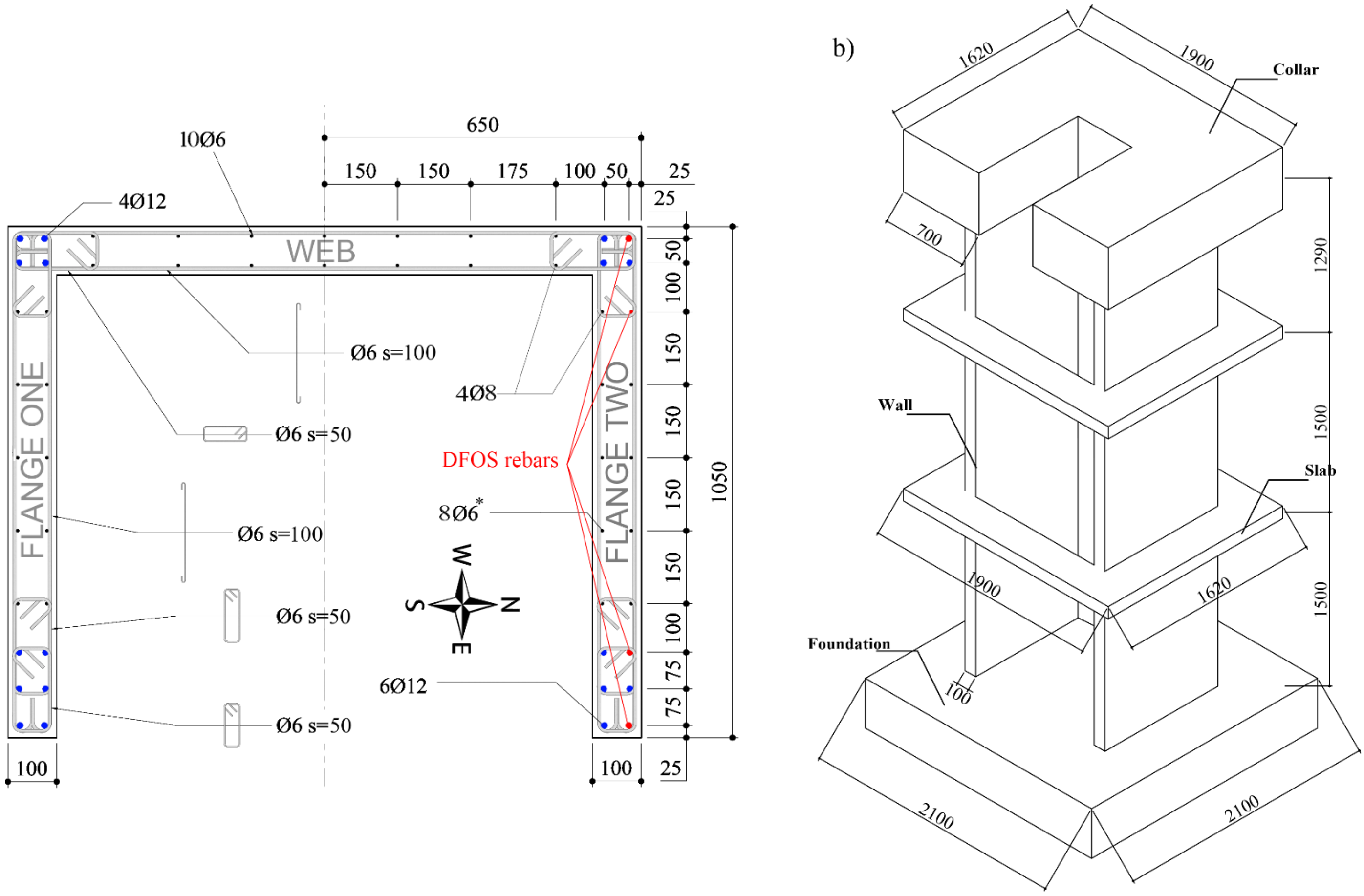

Figure 1 Test unit UWS1 (a) cross-section and reinforcement layout and (b) elevation view. All dimensions are in millimetres.

MATERIAL PROPERTIES

The design concrete strength, defined as the 28-day cylinder strength, for the wall units was 30 MPa. Table 1 presents the compressive strengths (f'_c) of the different wall components, measured from testing cylinders at 28 days. For each wall component, three cylinders were tested, and the mean values of these tests are listed in Table 1. Note that the test for unit UWS1 was conducted 41 days after casting the concrete.

Table 1 Mean values of the concrete cylinder compressive strengths.

	Cylinder compressive strength (f'_c, MPa)		
	Foundation	Wall	Collar
UWS1	29.6	27.0	34.6

Table 2 lists the yield strength (f_y), ultimate strength (f_u), yield strain (ε_{sy}), ultimate strain (ε_{su}), and Young's modulus (E_s) for the different materials and bar diameters, where applicable. Additionally, the hardening strain (ε_{sh}), indicating the end of the constant strength yield plateau for steel, is provided in Table 2. In compliance with the requirements of Eurocode 8 to ensure ductility and energy dissipation, Class C steel was used for the longitudinal reinforcing bars in unit UWS1 and for the transverse (shear and confinement) reinforcement in both wall units. Figure 2a shows the stress-strain relationship for the Class C steel with a 12mm diameter, used for the longitudinal reinforcement at the boundary ends of unit UWS1.

Table 2 Mechanical properties of the reinforcing bars

Material	d_{bl}	$f_y{}^a$	f_u	ε_{sy}	ε_{sh}	ε_{su}	E_s	n
-	[mm]	[MPa]	[MPa]	[mm/mm]	[mm/mm]	[mm/mm]	[GPa]	−
Steel	6*	577	623	0.0028	−	0.046	208	5
Steel	6#	550	676	0.0027	−	0.095	207	3
Steel	8	538	664	0.0027	0.0268	0.12	196	3
Steel	12	580	690	0.0029	0.021	0.101	199	3

* transverse steel (i.e., shear reinforcement, confinement ties)

longitudinal steel

TEST SETUP

The wall unit, one of which is shown in Figure 3, were tested on the large shake table at the National Laboratory for Civil Engineering (LNEC) in Lisbon, Portugal. The maximum capacities of the horizontal actuators are 700 kN in the west-east (WE) direction and 500 kN in the north-south (NS) direction. Figure 1a illustrates the orientation of the wall relative to these cardinal directions. The positive axis conventions are defined as north to south and west to east. The shake table can achieve maximum displacements and velocities of ±200 mm and ±700 mm/s, respectively, in either direction. The table has a maximum payload capacity of approximately 40 tons.

To generate the required lateral inertial forces and reach the flexural capacity of the scaled wall units, several mass blocks were used. These included 1.13-ton and 0.59-ton blocks, which were connected to the collar (head) of the wall. These mass blocks have a cross-section of 840 mm × 840 mm, with thicknesses of 250 mm for the 1.13-ton blocks and 130 mm for the 0.59-ton blocks. A total of 20 (arranged in a 4 x 5 grid) 1.13-ton mass blocks were placed on the collar of the wall unit, along with four 0.59-ton mass blocks. This setup results in a total mass of 24.96 tons above the collar. Including the mass of the wall unit's collar, which is 3.27 tons, the total mass at the top of the wall is 28.23 tons.

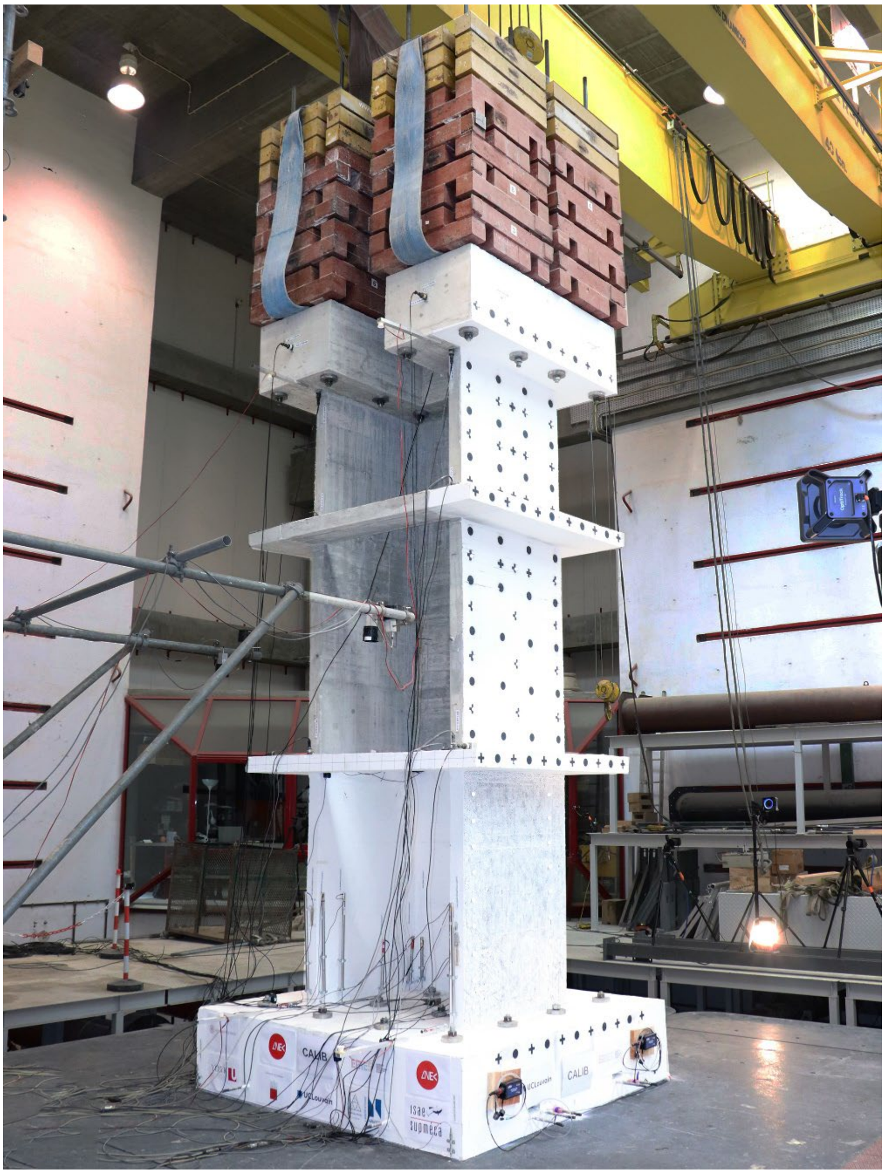

Figure 2 Photo of test unit UWS2 taken from the north-east prior to testing.