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Experimental behavior of lintels for AAC masonry buildings: comparison among different solutions

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Abstract

The paper investigates the experimental behavior up to failure of different types of lintels for AAC masonry buildings. At first, precast highly-reinforced AAC lintels, that are quite widespread on the European and Turkish market, were tested in flexure, by considering different reinforcement type and arrangement. The second analyzed solution is represented by RC lintels cast within three juxtaposed special AAC elements with U section, acting as formwork and final external finishing. Also in this case, the effect of reinforcement type (lattice girders, ordinary rebars or a combination of them) and reinforcement amount on the bearing capacity and mode of failure was analyzed. The experimental results highlight that precast AAC lintels available on the market are very light and are characterized by high stiffness in bending; however, being usually over-reinforced, their failure is quite brittle. On the contrary, RC lintels cast within U-shaped AAC blocks ("combined AAC-RC" specimens) are heavier but can be easily designed to have a ductile behavior, by simply following design Standard recommendations for ordinary RC elements.

Keywords

Autoclaved aerated concrete, precast AAC lintels, combined AAC-RC lintels, reinforcement type, experimental tests

1 Introduction

In masonry structures, the realization of openings within the walls requires the insertion of lintels, which can be made with different technical solutions, like steel, precast or cast-in-place concrete, and masonry. In case of Autoclaved Aerated Concrete (AAC) masonry buildings, precast AAC lintels are often adopted, since they allow to limit thermal bridges within the wall, being made of the same material of the surrounding masonry blocks and having themselves interesting thermal insulation properties. Other advantages related to the choice of precast AAC lintels are their lightness (that allows reducing the loads acting on foundations), as well as their fast and easy assembly, which does not require labour-consuming casting operations that are instead necessary in case of concrete lintels [1]. So far, few specific studies on the behaviour of precast AAC lintels can be found in the literature [2-7], and therefore further experimental investigations are certainly required. This need to deepen the knowledge on light precast lintels is also justified by the fact that, for a given cross-section height (e.g., 250 mm) and lintel span (e.g., around 2000 ± 200 mm), the products available on the construction market are characterized by different reinforcement ratios and different type of rebar coatings. Indeed, special coats are often adopted by Manufacturers in order to protect steel from corrosion during the production process (from green cake production - with direct exposition to oxygen and water, to autoclaving - with the presence of hot steam and gases [1]). Given the porous nature of AAC, the coating protects the reinforcement from corrosion also during the service life of the element. Due to the presence of external coating, longitudinal rebars are usually welded to transverse reinforcement. The latter is realized with U-shaped open stirrups, having the same diameter or smaller. Another difference among precast AAC lintels available on the market having similar geometric features is precisely the stirrup amount and distribution within the lintel themselves (i.e., only near supports, distributed throughout the element span with constant spacing, or with a denser spacing near supports).

Another possibility that has been recently explored by AAC Manufacturers in order to reduce thermal bridges and to allow having a seamless finish for the interior and the exterior of the building, is represented by Reinforced Concrete (RC) lintels cast within special U-shaped AAC blocks (so-called combined lintels, according to [8]). In this case, the U-shaped blocks act as disposable formwork for casting and as external finish at the same time, having the same characteristics of the surrounding masonry. U-shaped blocks available in Italy typically have a length of 600 mm and thickness ranging from 200 to 300 mm, corresponding to an internal thickness for concrete casting approximately varying from 100 to 140 mm. These blocks should be connected to each other by means of thin mortar layers. In this case, traditional reinforcement without specific protection can be used, and its design can be simply made according to design Standard recommendations for RC elements (e.g. [9]).

As regards the design of lintel reinforcement, it is common to consider a uniformly distributed load deriving from the wall and the floor acting above the lintel, assumed as a simply supported element. Usually, the simplified assumption of arching action is considered, and therefore the load applied on the lintel can be reduced to the weight of the masonry included within a triangular area above the lintel, while the remaining part of the load directly acts on the masonry elements at the side of the opening [10]. However, this assumption can be applied only in case of a uniform load above the triangle apex, otherwise, the whole acting load should be applied to the lintel [3]. In case of AAC precast lintels with coated rebars, special attention should be also paid to the efficiency of reinforcement anchorage in AAC, since anchorage failure is typically accompanied by a brittle shear failure of the lintel [2].

This work discusses and compares the results of an experimental program carried out at the Laboratory of Testing, Materials and Structures of the University of Parma, on different types of lintels for AAC masonry buildings. The two lintel typologies discussed above were considered for the purpose (that is, precast AAC lintels and combined AAC-RC lintels), by focusing the attention on typical geometric dimensions adopted in the construction of low-rise residential buildings: cross-section height equal to 250 mm, cross-section width varying between 200 and 250 mm, and element span ranging between 1750 mm and 2200 mm. In case of precast AAC lintels, 4 specimens, chosen from the possible solutions available on the market, were tested in flexure according to EN 846-9 [11] to study the influence of different rebar coating and reinforcement distribution within the element. As concerns combined AAC-RC lintels, flexural tests were carried out on three specimens, by varying also in this case the type of longitudinal reinforcement (lattice girders, ordinary rebars or a combination of them), and stirrup layout.

2 Experimental program

2.1 Precast AAC lintels

The main geometric characteristic of precast AAC lintels, together with the adopted nomenclature, are summarized in Table 1, while Figures 1 – 4 show the reinforcement layout. Apart from a quoted sketch of rebar diameter and position within the lintels, Figures 1-4 also report a general view of the destructive surveys made at the end of the tests, so to verify the type and position of declared reinforcement.

Table 1 Main characteristics of the precast AAC lintel specimens

ID	b (mm)	h (mm)	L (m)
AAC 25x25-1	250	250	2.20
AAC 24x25-2	240	250	1.75
AAC 20x25-3	200	250	1.75
AAC 20x25-4	200	250	2.00

As already stated, based on the assumed lintel span (approximately 2000 ±200 mm) and cross-section height (250 mm), AAC precast specimens were chosen among those available on the marked, based on the production of different AAC European Manufacturers.

Specimen AAC 25x25-1 was reinforced with 4 longitudinal zinc-coated steel rebars with 4 mm diameter. Transverse reinforcement was lacking, apart from a couple of hooked rebars placed at lintel supports, which were necessary for the construction of the reinforcement cage (Figure 1).

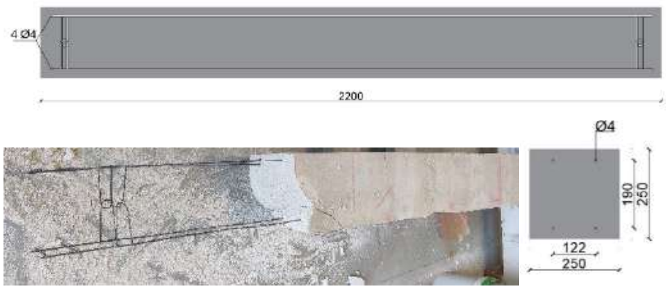


Figure 1 Geometric features of specimen AAC 25x25-1 and reinforcement layout (dimensions in mm).

Specimen AAC 24x25-2 was reinforced with 6 longitudinal plain steel rebars with 8 mm diameter, protected by a corrosion-resistant coating. The same coating was also adopted for the U-shaped stirrups, with 6 mm diameter and a constant spacing of 50 mm in the central part of the lintel and a reduced spacing equal to 25 mm near the supports. Stirrups and longitudinal rebars were welded to each other before coating (Figure 2).

Figure 2 Geometric features of specimen AAC 24x25-2 and reinforcement layout (dimensions in mm).

Specimens AAC 20x25-3 and AAC 20x25-4 were characterized by the same geometric features and reinforcement layout and type of coating (anti-corrosive painting), see Figures 3 and 4. In both cases, reinforcement consisted of 6 longitudinal plain rebars and ϕ6 mm U-shaped stirrups with a constant spacing equal to 50 mm. The only difference between them was represented by the diameter of longitudinal rebars, equal to 8 mm for the specimen AAC 20x25-3, and 10 mm for specimen AAC 20x25-4.

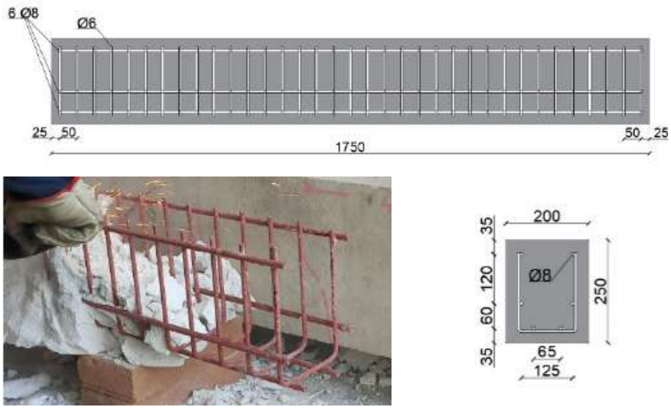


Figure 3 Geometric features of specimen AAC 20x25-3 and reinforcement layout (dimensions in mm).

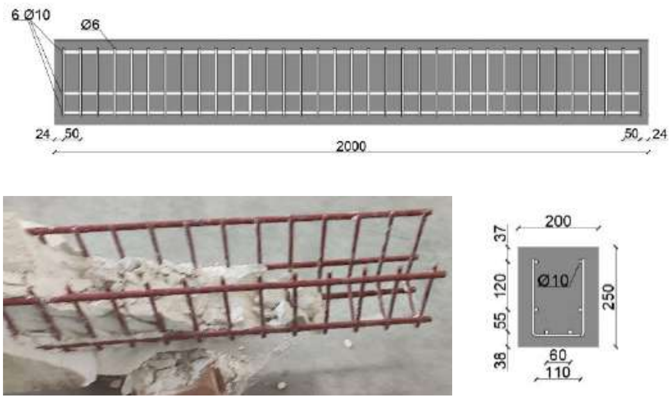


Figure 4 Geometric features of specimen AAC 20x25-4 and reinforcement layout (dimensions in mm).

2.2 Combined AAC-RC lintels

Combined AAC-RC lintels were realized at the laboratory by an expert technician, by using special U-shaped AAC blocks produced by an Italian Manufacturer and a high-strength ready mixed concrete available on the Italian market. In more detail, three U-shaped AAC blocks were first aligned and connected to each other by means of an appropriate thin mortar layer, so to reach an approximate total length of 1800 mm. Then, the reinforcement cage was positioned within the internal channel of the blocks, and concrete was finally cast. Specimens were covered by means of a plastic sheet for 14 days and then they were cured at laboratory conditions until the day of the test. A general view of casting operations is shown in Figure 5a, while Figure 5b shows the specimen's final appearance. The main geometric characteristic of combined AAC-RC lintels, together with the adopted nomenclature, are summarized in Table 2, while Figures 6 – 8 show the reinforcement layout.

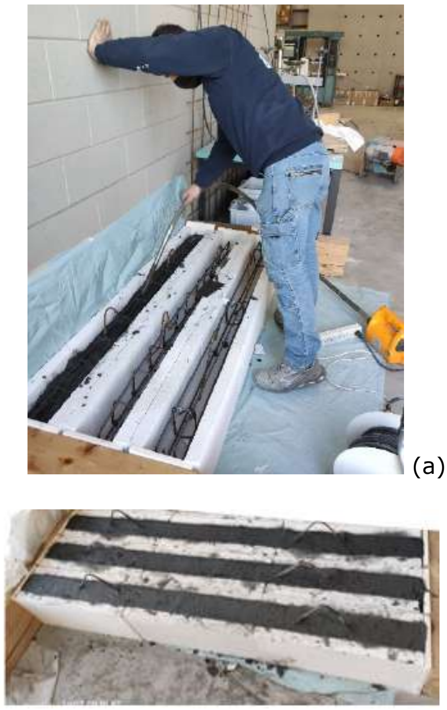


Figure 5 (a) Casting operation, and (b) general view of the specimens after casting.

Table 2 Main characteristics of combined AAC-RC lintel specimens

ID	b (mm)	h (mm)	L (m)
AAC-RC-1	200	250	1.80
AAC-RC-2	200	250	1.80
AAC-RC-3	250	250	1.80

As can be observed, specimens AAC-RC-1 and AAC-RC-2 had the same transverse cross-section (200 mm x 250 mm) and were reinforced with a lattice girder (similar to the steel mesh commonly used for the reinforcement of mortar joints in masonry), formed by welded steel wires with 5 mm diameter, as shown in Figure 9.

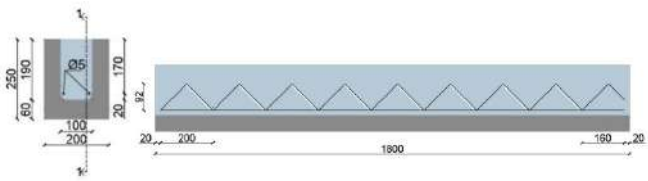


Figure 6 Geometric features of specimen AAC–RC-1 and reinforcement layout (dimensions in mm).

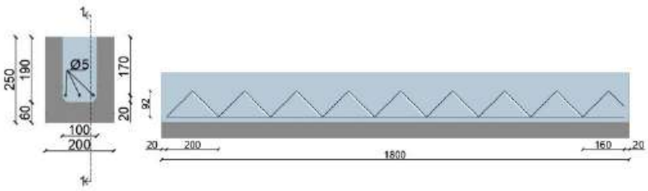


Figure 7 Geometric features of specimen AAC–RC-2 and reinforcement layout (dimensions in mm).

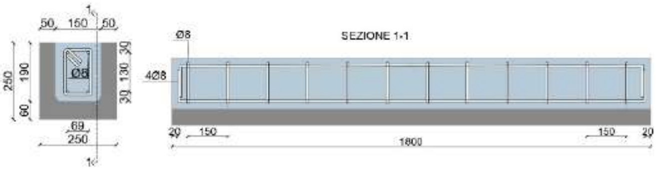


Figure 8 Geometric features of specimen AAC–RC-3 and reinforcement layout (dimensions in mm).

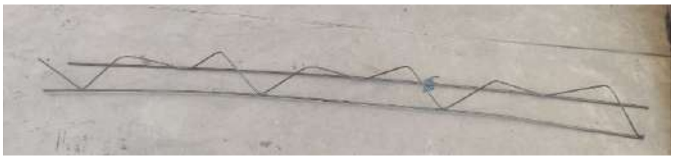


Figure 9 Lattice girder reinforcement used for specimens AAC-RC-1 and AAC-RC-2.

In specimen AAC-RC-2, an additional steel wire with 5 mm diameter was added to the lattice girder at beam intrados, so having a total of 3 longitudinal bars. Specimen AAC-RC-3 was instead reinforced with four B450C ribbed bars, having diameter equal to 8 mm, and ϕ8mm stirrups, with a constant spacing of 150 mm. Due to the increased footprint of the reinforcement cage, in this case it was necessary to adopt larger U-shaped blocks (with a depth of 250 mm instead of 200 mm).

2.3 Bending tests: experimental setup

Bending tests were performed according to EN 846-9 [11], by adopting the four-point bending scheme depicted in Figures 10 and 11. The experimental setup is also analogous to that suggested in [12]. Tests were carried out by using an Instron 5882 universal testing machine with a maximum capacity of 100 kN. According to the drawing of Figure 11, two welded HE160A steel beams were fixed onto the press bench, acting as a support for the lintel specimen through two steel hinges surmounted by steel plates. In order to redistribute the load applied by the loading cell, a further HE200 steel beam was used with two welded steel rollers.

Under each roller, a spreader plate was positioned, with a length between 50 mm and 200 mm as recommended in [11]. Tests were performed under displacement control, and lintel displacements at midspan and at bearing support were monitored through three Linear Variable Displacement Transducers (LVDT), as shown in Figure 12.


(a)

(b)

Figure 10 General view of the adopted experimental setup: (a) frontal view, (b) lateral view.

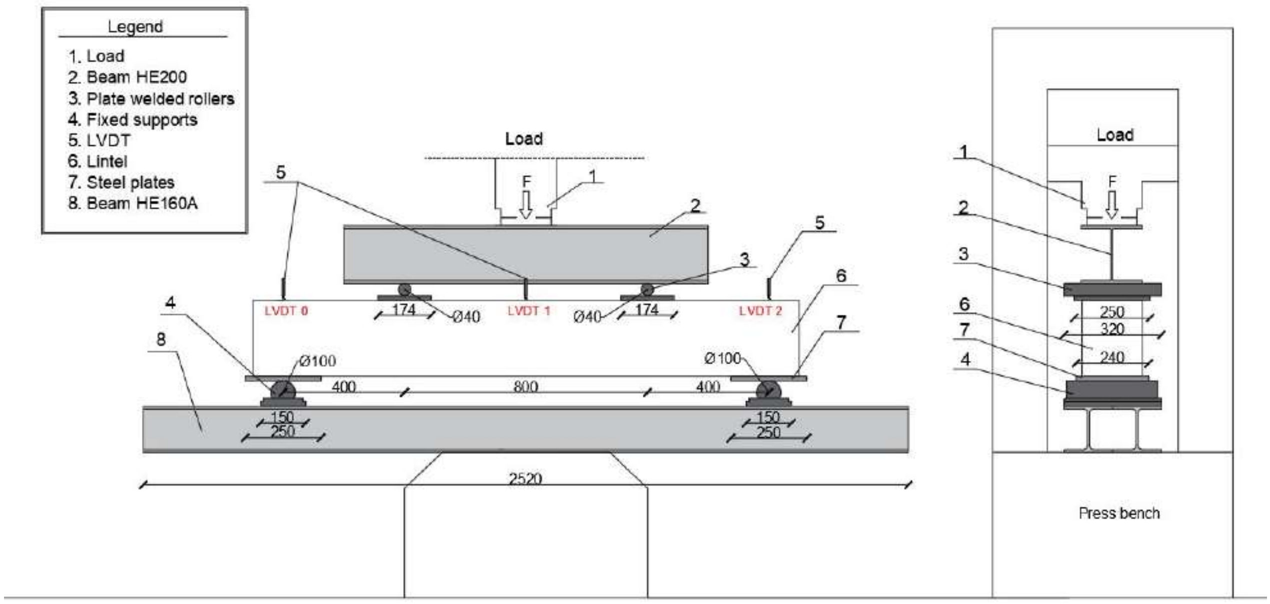


Figure 11 Sketch of the adopted test setup.

Figure 12 Detail of the LVDT applied at midspan.

2.4 Material characterization

After the execution of bending tests on lintels, the mechanical characterization of constituent materials was also carried out, by performing: 1) compression tests on concrete cylinders obtained from the same casting as the combined AAC-RC lintels, according to EN 12390-3 [13]; 2) compression tests on AAC core samples extracted from the precast lintels, according to EN 772-1 [14]; 3) tension tests on rebar specimens extracted from both lintel series, according to EN 15630-1 [15]. As an example, Figures 13 and 14 show some specimens of AAC and steel extracted from precast lintels.

Figure 13 AAC cores extracted from precast lintels after bending test execution.

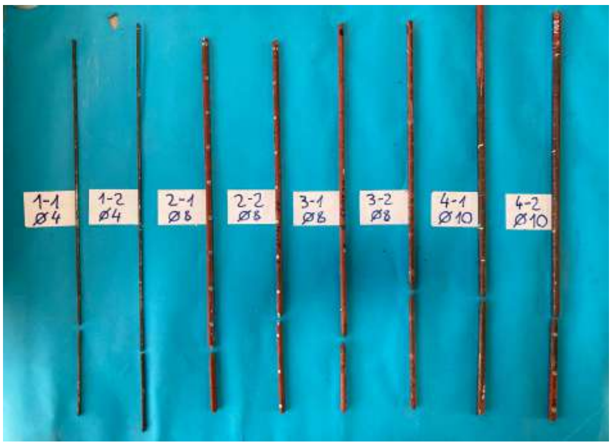


Figure 14 Rebar samples extracted from precast lintels after bending test execution.

As regards concrete cylinders, they were cast together with combined AAC-RC lintels, they were demoulded after 3 days and then cured in water until the execution of compression tests (after 28 days from casting). The cylinders had a nominal diameter of 100 mm and a height equal to 200 mm, so having a slenderness ratio equal to 2. The measured density was approximately equal to 2000 kg/m^3. Compressive strength, calculated as the mean value referred to 3 cylindrical specimens, approximately reached 22 MPa.

A variable number of AAC cores, with 75 mm diameter and 80 mm height, were extracted from the uncracked parts of precast lintels at the end of flexural tests. For two lintels, it was possible to extract 4 cores, while for the remaining two, only two cores were cut, according to Table 3. The cores were preliminary conditioned in a ventilated oven until they reached of a constant mass value. Then, the specimens were subjected to compression tests, whose results are summarized in Table 3. Since precast lintels were provided by different Manufacturers, compressive strength was not the same among different specimens but ranged from 3.77 MPa to 5.89 MPa.

Table 3 Compressive strength of AAC cores extracted from precast lintels.

ID	**Core #**	**f_{AAC} (MPa)**	**$f_{AAC,mean}$ (MPa)**
AAC 25x25-1	1-1	3.60	3.77
	1-2	3.71	
	1-3	4.13	
	1-4	3.63	
AAC 24x25-2	2-1	6.08	5,96
	2-2	5.83	
AAC 20x25-3	3-1	3.78	3,89
	3-2	3.99	
AAC 20x25-4	4-1	4.41	4,69
	4-2	4.90	
	4-3	4.37	
	4-4	5.06	

Rebar specimens with a nominal length of 50 mm were also cut from both precast and combined lintels, after flexural tests. These specimens were taken from lintel extrados, in the support region. The main results in terms of effective rebar diameter ϕ, yielding strength f_y and ultimate tensile strength f_t are summarized in Tables 4 and 5, for precast and combined lintels respectively. Rebars used in precast lintels had comparable values of tensile strength, but lower diameters (ϕ4) were characterized by a less ductile behaviour. As regards combined lintels, rebars with lower diameters (ϕ5) showed higher yielding and tensile strengths but were characterized by lower ultimate strains.

Table 4 Mechanical characterization of steel bars extracted from precast lintels

ID	Bar #	ϕ (mm)	f_y (MPa)	f_t (MPa)
AAC 25x25-1	S1-1	4.0	506.4	525.7
	S1-2	4.0	523.8	581.7
AAC 24x25-2	S2-1	8.1	-	580.7
	S2-2	8.1	-	548.9
AAC 20x25-3	S3-1	8.1	556.5	604.6
	S3-2	8.1	563.7	609.1
AAC 20x25-4	S4-1	10.0	538.7	567.5
	S4-2	10.1	537.0	573.4

Table 5 Mechanical characterization of steel bars extracted from combined lintels

ID	Bar #	ϕ (mm)	f_y (MPa)	f_t (MPa)
AAC-RC-1	SC1-1	5.0	669.2	693.5
	SC1-2	5.0	670.4	688.5
	SC1-3	5.0	700.9	721.4
	SC1-4	5.0	705.2	742.4
AAC-RC-3	SC2-1	7.9	506.3	608.5
	SC2-2	7.9	496.3	605.5

Table 6 summarizes the corresponding values of the geometric and mechanical reinforcement ratios (in percentage), calculated as:

$$\rho = A_s / A_c \qquad (1)$$

and:

$$\omega = A_s \cdot f_y / (A_c \cdot f_c) \qquad (2)$$

where A_s is the area of the longitudinal reinforcement in tension, $A_c = b \cdot d$, f_y is the experimental mean value of steel yielding strength (reported in Tables 4 and 5), and f_c is the mean experimental value of AAC compressive strength (for precast lintels, Table 3) and of concrete compressive strength (for combined lintels, assumed equal to 22 MPa). The effective depth d can be also deduced from Figures 1-4 and 6-8.

Table 6 Mechanical characterization of steel bars extracted from combined lintels

ID	A_s (mm²)	b (mm)	d (mm)	ρ (%)	ω (%)
AAC 25x25-1	25.1	250	220	0.05	6.2
AAC 24x25-2	100.5	240	215	0.19	18.4
AAC 20x25-3	100.5	200	215	0.23	33.6
AAC 20x25-4	157.1	200	212	0.37	42.5
AAC-RC-1	39.3	100	170	0.23	7.2
AAC-RC-2	58.9	100	170	0.35	10.8
AAC-RC-3	100.5	150	160	0.42	9.5

Table 7 Experimental results of flexural tests on precast and combined AAC lintels: cracking load, ultimate load and detected failure mode.

ID	b (mm)	h (mm)	L (m)	Long rebars	F_{cr} (kN)	F_u (kN)	Failure mode	M_{cr} (kNm)	M_u (kNm)	V_u (kN)	EI (Nmm²)
AAC 25x25-1	250	250	2.20	2+2ϕ4	7.02	15.42	Flexure	1.40	3.08	>7.71	6.50E11
AAC 24x25-2	240	250	1.75	4+2 ϕ8	35.17	79.54	Shear	7.03	>15.91	39.77	9.87E11
AAC 20x25-3	200	250	1.75	4+2 ϕ8	22.07	69.22	Shear	4.41	>13.84	34.61	9.97E11
AAC 20x25-4	200	250	2.00	4+2 ϕ10	21.52	100	(*)	4.30	>20	>50	1.26E12
AAC 20x25-4 3PB					-	54.89	Flexure	-	21.96	>27.44	1.05E12
AAC-RC-1	200	250	1.80	2 ϕ5	5.81	18.28	Flexure	1.16	3.66	>9.14	6.29E11
AAC-RC-2	200	250	1.80	3 ϕ5	9.00	26.29	Flexure	1.80	5.26	>13.14	6.73E11
AAC-RC-3	250	250	1.80	2+2 ϕ8	22.20	43.14	Flexure	4.44	8.63	>21.56	1.55E12

(*) Failure was not achieved due to the reaching of the maximum capacity of the loading press, therefore the test was repeated under a 3PB scheme.

In case of combined AAC-RC beams, it was assumed, as first approximation, that A_c is referred to the area of the reinforced concrete part only, so neglecting the possible contribution of surrounding AAC.

3 Flexural tests on lintels: discussion of experimental results and crack patterns at failure

The experimental results of flexural tests on lintels are summarized in Figure 15, in terms of total applied load F vs. midspan deflection, as well as in tabular form in Table 7. In particular, Table 7 reports the cracking load F_{cr}, the ultimate load F_u, the detected failure mode, the cracking moment M_{cr}, the ultimate moment M_u and the ultimate shear V_u.

Flexural stiffness EI was calculated from the elastic branch of the load-midspan deflection curve, as:

$$EI = \frac{(F/2)\,a}{24\,f}\left(3L^2 - 4a^2\right) \qquad (3)$$

being f the midspan deflection, a the distance between the applied load $F/2$ and the support (equal to 400 mm, see Figure 11), and L the lintel span.

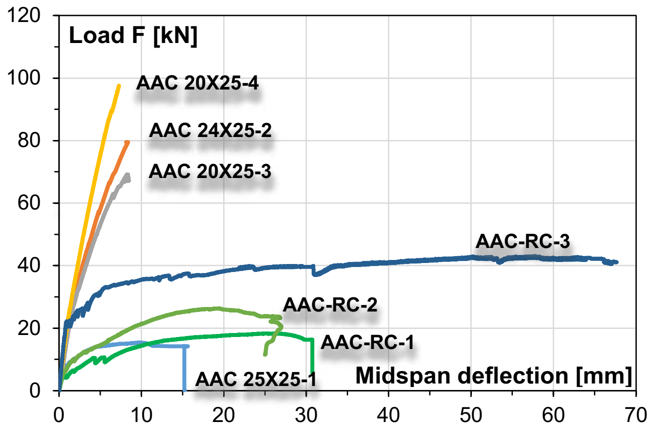


Figure 15 Experimental total load F – midspan deflection f curves.

As can be seen, the behaviour of the lightly reinforced precast lintel (AAC 25x25-1) was quite similar to that of the combined lintel AAC-RC-1, which was indeed characterized by a quite similar value of mechanical reinforcement ratio ω (see Table 6). The experimental crack pattern at failure of specimen AAC 25x25-1, shown in Figure 16, presented several flexural cracks with very small width in the central part of the lintel, while no cracks appeared in the support regions. In correspondence with lintel failure, the longitudinal reinforcement was yielded.

Figure 16 Crack pattern at failure for precast specimen AAC 25x25-1.

The other three precast lintels, with heavier longitudinal reinforcement, were characterized by high values of the failure load. In case of specimen AAC 24x25-2 and AAC 20x25-3, a brittle shear failure was detected, with the appearance of wide inclined cracks starting from supports (Figures 17a-b, and Figure 18a). Specimen AAC 24x25-2 was also characterized by the detachment of the reinforcement cover (Figure 17a), so highlighting that also the AAC core within the reinforcement cage was cracked.

(a)

(b)

Figure 17 Crack pattern at failure for precast specimen AAC 24x25-2: (a) general view; (b) detail of the support region just before the detachment of AAC cover.

(a)

(b)

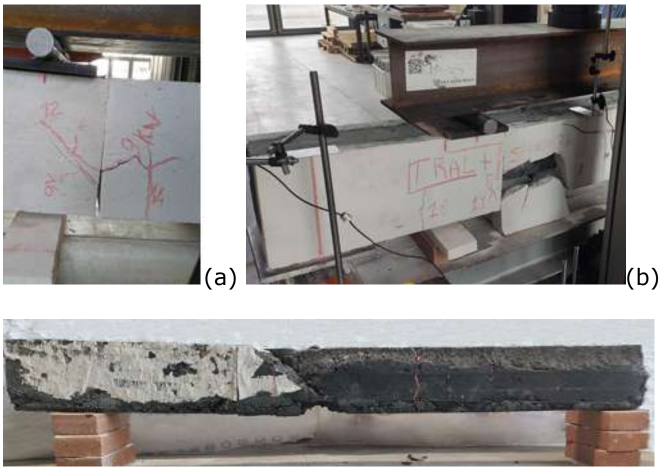
Figure 18 Crack pattern at failure for precast specimens: (a) AAC 20x25-3; (b) AAC 20x25-4.

As concerns specimen AAC 20x25-4, the test ended for the achievement of the maximum capacity of the universal testing machine, without the appearance of significant cracks in the lintel. In order to evaluate the ultimate bending moment M_u, the test was then repeated under a three-point bending scheme (3PB) with the same span length. In that case, specimen failure took place for an applied load almost equal to 55kN. Besides the formation of sub-vertical flexural cracks in the central region of the specimen, crack pattern at failure was also characterized by the presence of inclined cracks starting from the support, with an inclination almost equal to 45°, as illustrated in Figure 18b.

These results are not surprising if we take in mind that, given the small span-to-depth ratio of the tested specimens, the loading scheme suggested in [11] for flexure and shear are very similar to each other in terms of distance between the two-point loads and the supports. Moreover, other works in the literature have highlighted that the shear capacity of precast AAC lintels with coated reinforcement is conditioned by the anchorage capacity of the reinforcement cage. An increase in lintel strength can be obtained by increasing anchorage capacity; however, the corresponding failure has a brittle nature [2]. More ductile failures can be achieved by adding diagonal ties that are not present in the reinforcement scheme of the tested specimens.

Combined AAC-RC lintels showed a lower failure load, ranging between 18 kN and 43 kN depending on the adopted reinforcement ratio, and were characterized by ductile flexural behaviour. The corresponding experimental crack pattern at failure is reported in Figures 19-21. In specimen AAC-RC-1, all the cracks were localized in correspondence of the central AAC U-shaped element, in the region subjected to constant moment. As can be observed from Figure 18, part of the AAC cover started to detach from the internal RC core for an applied load almost equal to 15 kN.

Figure 19 Crack pattern at failure for specimen AAC-RC-1.



(a) (b) (c)

Figure 20 Specimen AAC-RC-2: (a) detail of the opening of the joint between U-shaped AAC blocks during the test; (b) detachment of AAC cover at the end of the test; (c) crack pattern at failure after the removal of the external AAC cover.

In specimen AAC-RC-2, the first crack developed in the joint between two adjacent U-shaped AAC blocks for an applied load almost equal to 9 kN (Figure 20a). As loading increased, this crack extended towards the extrados of the element, so leading to the detachment of the lower part of the AAC cover from the concrete core (Figure 20b). Concrete crushing interested the upper part of the concrete core in the central region of the lintel. The crack pattern in correspondence with the failure load is shown in Figure 20c, after the removal of AAC cover; as can be seen, several sub-vertical flexural cracks formed in the constant moment region.

(a) (b)

Figure 21 Crack pattern at failure for combined specimen AAC-RC-3: (a) with AAC covering; (b) after the removal of AAC covering.

Specimen AAC-RC-3 was interested by the development of flexural cracks for an applied load around 22 kN. Further increases in the applied load caused a large deflection of the element, which was followed by the detachment of the lower part of AAC cover, for F = 37 kN (Figure 21a). The test was stopped for a load reduction up to 20% of its maximum value. A ductile failure was detected, with yielding of longitudinal reinforcement.

4 Conclusions

This works presents the results of an experimental program dealing with the analysis of the behaviour of lintels for AAC masonry buildings, realized with precast AAC elements or with combined AAC-RC solutions. The attention was focused on lintels covering a span approximately equal to 2 m, with a cross-section height of 250 mm and a depth ranging between 200 and 250 mm. Based on the obtained results, the following conclusions can be drawn:

- Precast AAC lintels available on European construction market represent a good solution in terms of reduction of thermal bridges, lightness, and ease of assembly. Generally, these precast lintels are heavily reinforced and are characterized by the application of a painting on rebars acting as coating, in order to protect the reinforcement from corrosion, also due to the porous nature of AAC. The presence of this coating can however lead to a limited surface adhesion between longitudinal rebars and the surrounding AAC [16].
- Due to their high mechanical reinforcement ratio and to the presence of straight welded rebars, precast AAC lintels show a good bearing capacity (in terms of ultimate sustainable load) and limited deformability. Flexural cracks are almost hairline, with very limited widths. However, these lintels display brittle failures, that in most cases are associated with the appearance of inclined cracks spreading from the supports. In any case, it should be underlined that these sudden failures take place in correspondence of loading levels that are well above than those typical for residential bearing masonry buildings.
- Combined AAC-RC lintels are obtained through the casting of an internal RC core within a U-

shaped AAC channel, formed by juxtaposed blocks connected with thin mortar layers. For a given span and lintel cross-section, this solution is characterized by an almost doubled self-weight with respect to precast AAC elements.

- In case of limited flexural stresses in the lintels, like it often happens for low-rise residential buildings realized with AAC masonry, a lattice girder formed by small diameter steel wires can be adopted as longitudinal reinforcement, alone or with additional longitudinal steel wires at beam intrados. In that case, 200 mm x 250 mm U-shaped AAC blocks can be successfully used as disposable formwork and external covering. Failure takes place after the yielding of the reinforcement, which is in turn associated with the detachment of the lower part of the AAC cover. The bearing capacity (in terms of ultimate bending moment M_u) and the bending stiffness EI are comparable to that of the lightly reinforced precast lintel AAC 25x25-1, but in this case the width of flexural cracks is much more significant.
- In case of higher applied loads, it is necessary to enlarge the width of the RC core to host a traditional reinforcement cage, and therefore 250 mm x 250 mm U-shaped AAC blocks are required. In this way, an increase of the ultimate bending moment ranging between 64% and 135% can be obtained (with respect to specimens AAC-RC-2 and AAC-RC-1, respectively). The failure mode remains ductile, with large midspan deflection before failure attainment.

Further experimental studies on this topic would be certainly required, to also deepen the behaviour of AAC and AAC-RC lintels in shear.

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