

Appendix 1

Uniaxial tensile test reports

A1.1 INTRODUCTION

This appendix presents a detailed analysis of the experimental research described in Chapter 3 on the uniaxial tensile behavior of SFRC.

Regarding the scarcity of uniaxial tensile test results available in literature, this appendix aims at gaining insight into the material's behavior by means of extensive data of each tested specimen. Because of the complexity of the uniaxial tensile test method, know-how on several steps of the testing procedure could only be gained through own mistakes. This way, in order to provide a useful background for future works, this appendix points out the difficulties experienced during the execution of the testing procedure by including comments and photographs of the failed tests.

The results are organized as follows: 1) Specimens made of concretes from type A and then from type B; 2) Within each concrete type, four series are presented by ascending order of fiber content (0, 20, 40 and 60 kg/m³); 3) Within each serie, a brief resume of the average results is firstly presented and then the individual report for each of its six specimens is given.

A1.2 SERIE A0

Average results

0 kg/m³ of steel fibers



Characteristics

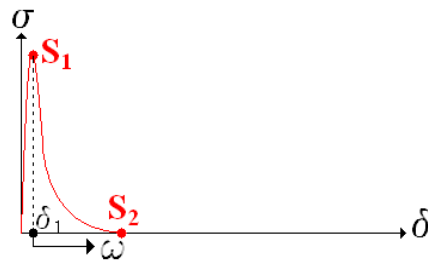
Concrete type	A
Fibers (kg/m ³)	0
Number of valid tests	3
Notation	A0

Reference values

Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

Number of fibers at the cracked section

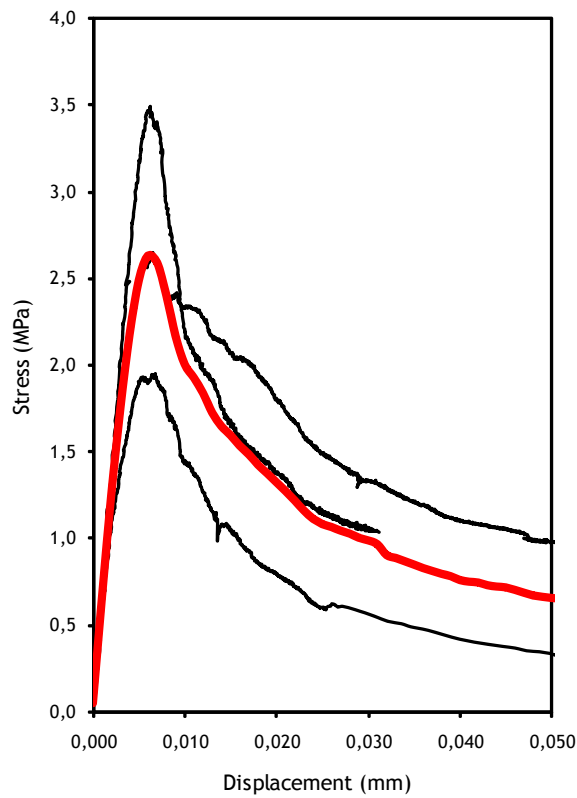
0



Significant values

Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	2.695	0.000
Last value (S ₂)	0.045	0.651	0.083

δ₁ = 0.0064 mm



Single test

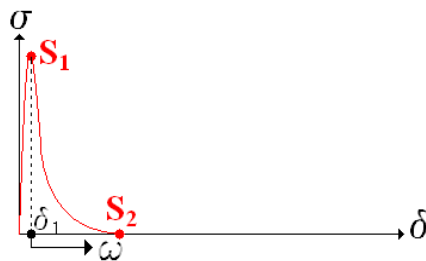
0 kg/m³ of steel fibers



<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	0
Specimen number	1
Notation	A0-1

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

<i>Number of fibers at the cracked section</i>
0



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)			
Last value (S ₂)			

Comments:

Test failed.
The extensometers were deficiently calibrated.

Single test

0 kg/m³ of steel fibers



Characteristics

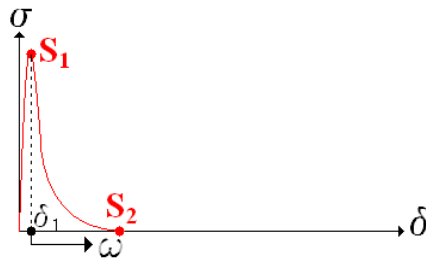
Concrete type	A
Fibers (kg/m ³)	0
Specimen number	2
Notation	A0-2

Reference values

Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

Number of fibers at the cracked section

0



Significant values

Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)			
Last value (S ₂)			

Comments:

Test failed.
The extensometers were deficiently calibrated.

Single test

0 kg/m³ of steel fibers



Characteristics

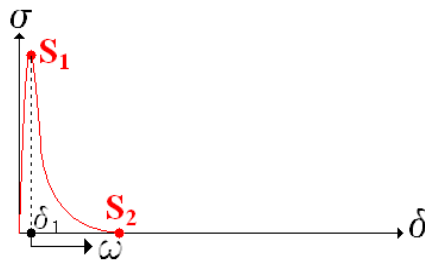
Concrete type	A
Fibers (kg/m ³)	0
Specimen number	3
Notation	A0-3

Reference values

Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

Number of fibers at the cracked section

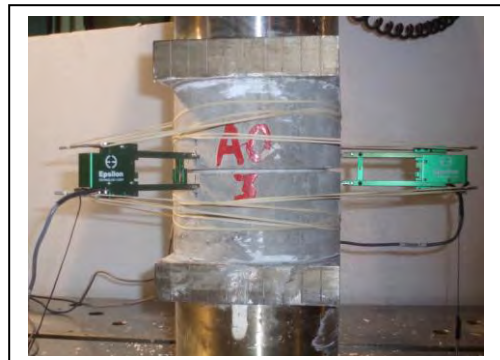
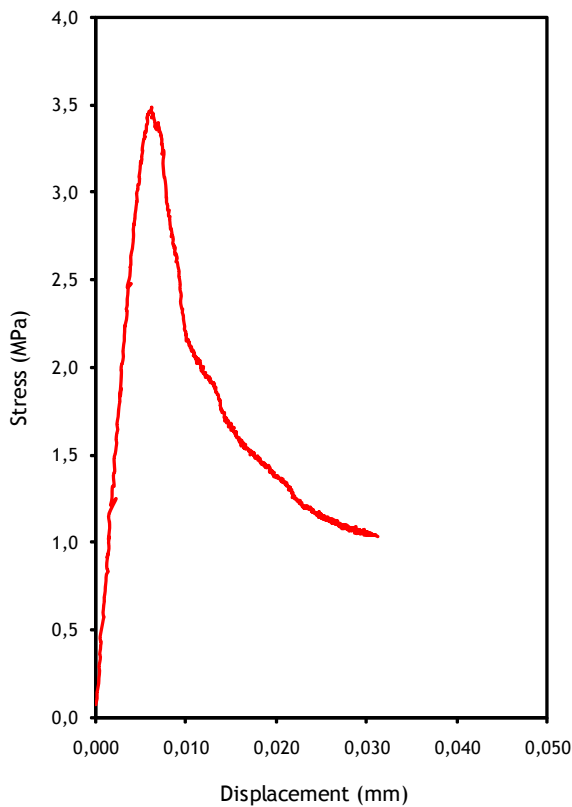
0



Significant values

Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	3.488	0.000
Last value (S ₂)	0.025	1.032	0.113

δ₁ = 0.0062 mm



Single test

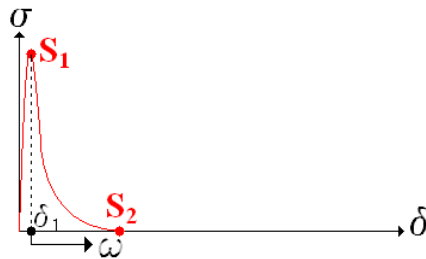
0 kg/m³ of steel fibers



<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	0
Specimen number	4
Notation	A0-4

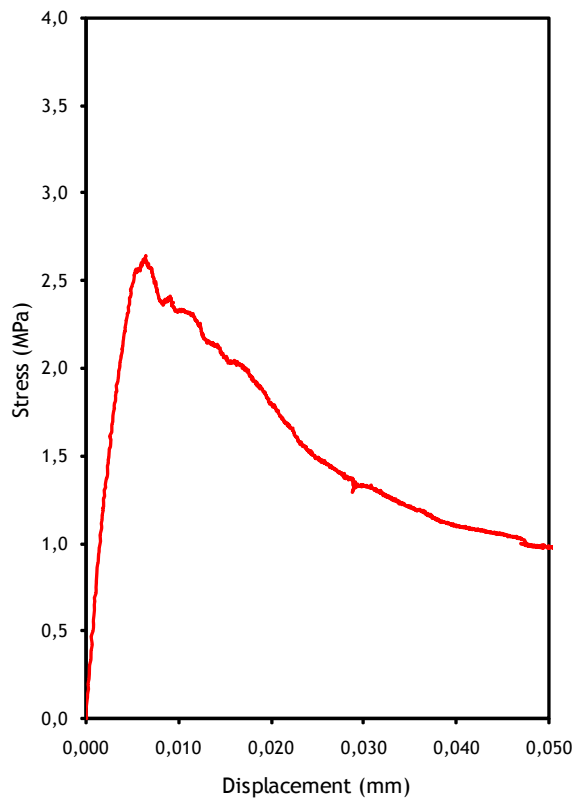
<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

<i>Number of fibers at the cracked section</i>
0



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	2.647	0.000
Last value (S ₂)	0.045	0.983	0.124

$\delta_1 = 0.0064 \text{ mm}$



Single test

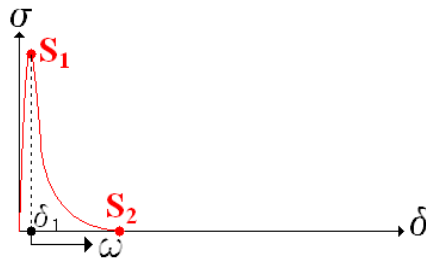
0 kg/m³ of steel fibers



<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	0
Specimen number	5
Notation	A0-5

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

<i>Number of fibers at the cracked section</i>
0



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)			
Last value (S ₂)			

Comments:

Specimen was damaged previously to the test.

Single test

0 kg/m³ of steel fibers



Characteristics

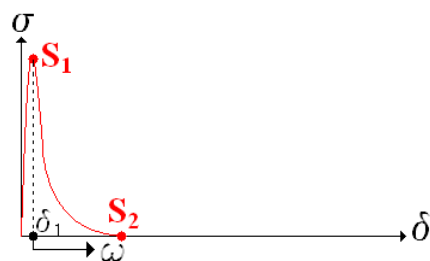
Concrete type	A
Fibers (kg/m ³)	0
Specimen number	6
Notation	A0-6

Reference values

Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.309	0.045
0.200	0.173	0.080

Number of fibers at the cracked section

0



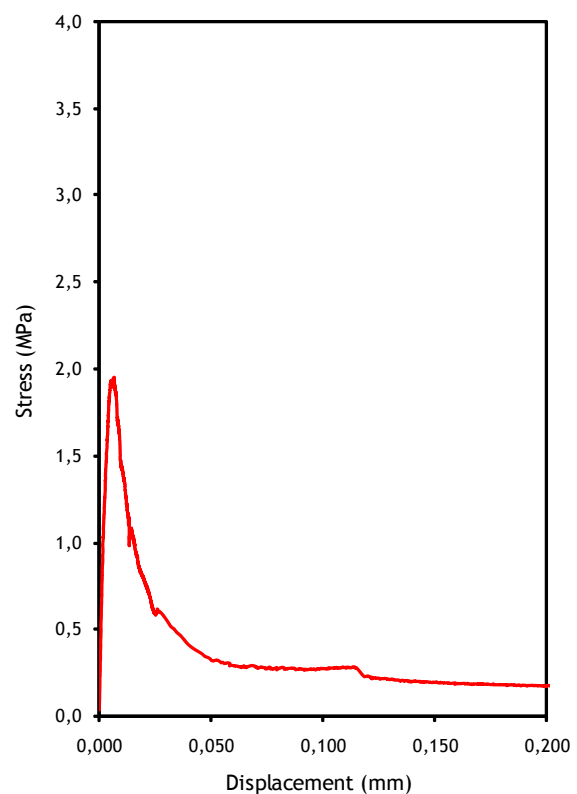
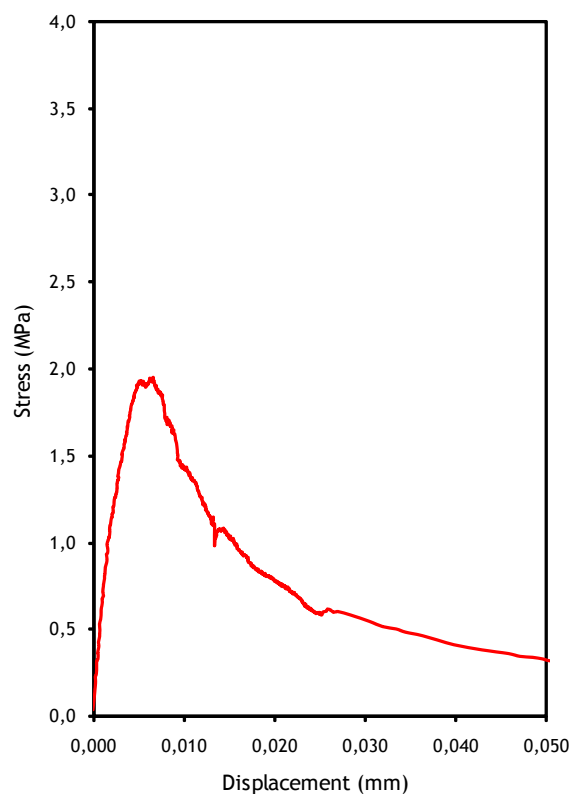
Significant values

Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	1.951	0.000
Last value (S ₂)	0.235	0.167	0.087

$$\delta_1 = 0.0066 \text{ mm}$$

Comments:

The last registered value is not significant because the measured forces are within a range smaller than the cell load error ($\Delta\sigma=0.220\text{MPa}$). Thereby, reliable results are within displacements up to 0.115mm.



A1.3 SERIE A20

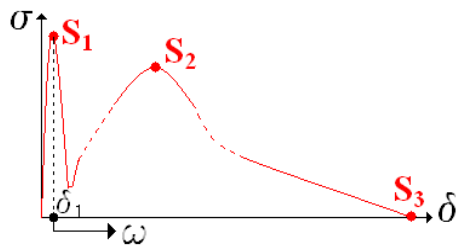
Average results

20 kg/m³ of steel fibers



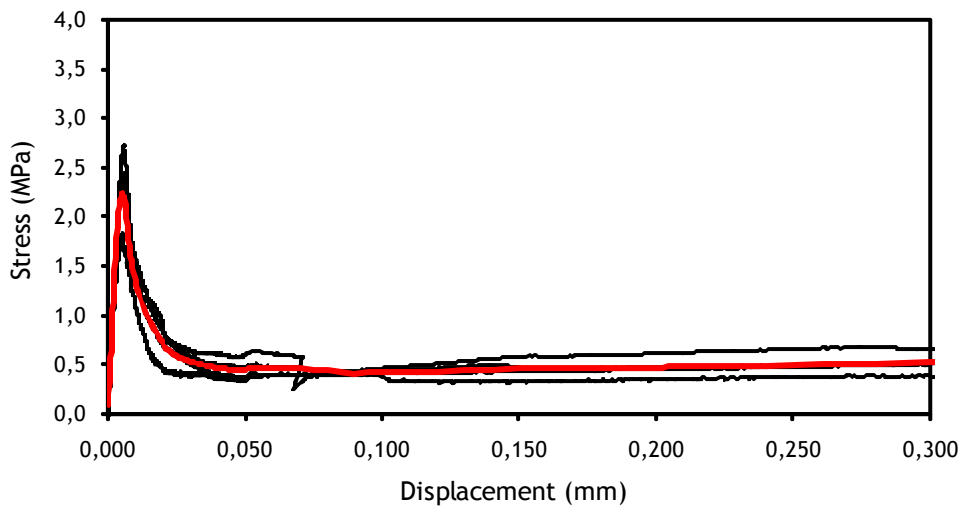
<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	20
Number of valid tests	4
Notation	A20
<i>Number of fibers at the cracked section</i>	
	32

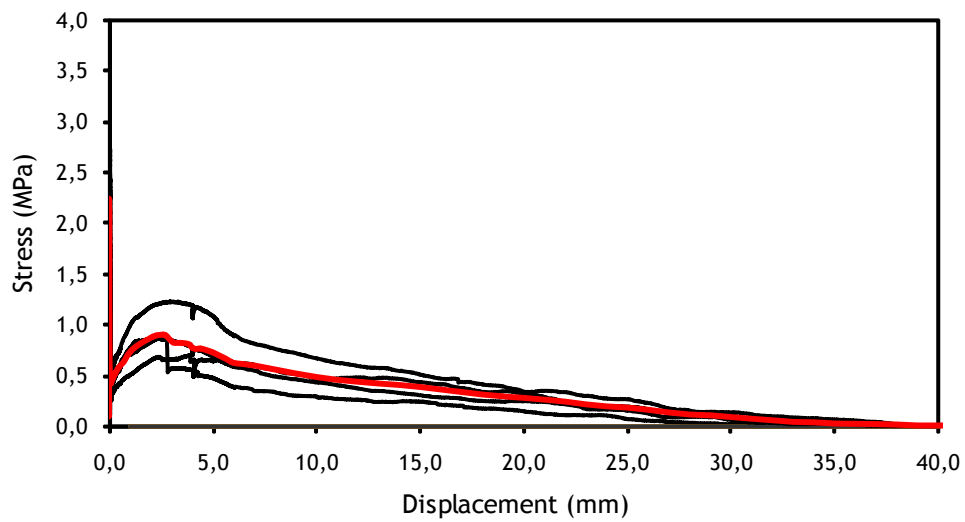
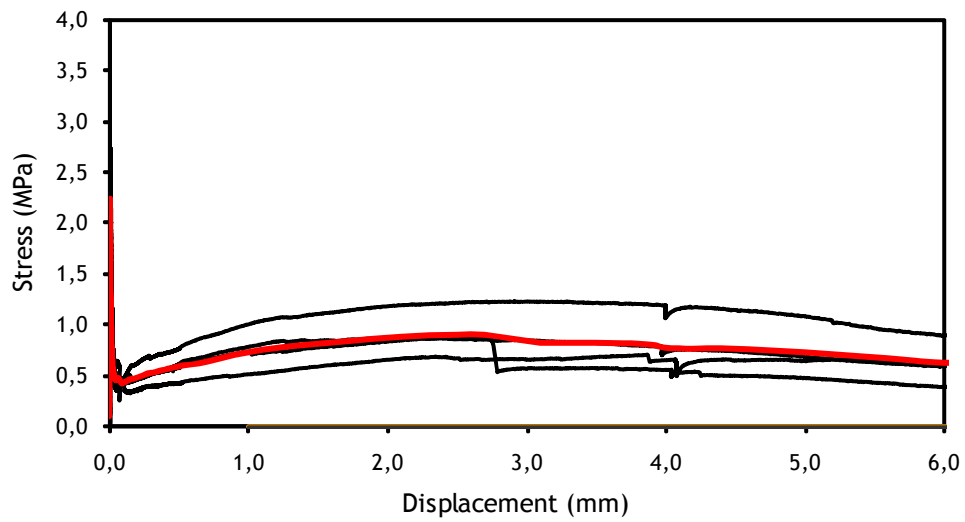
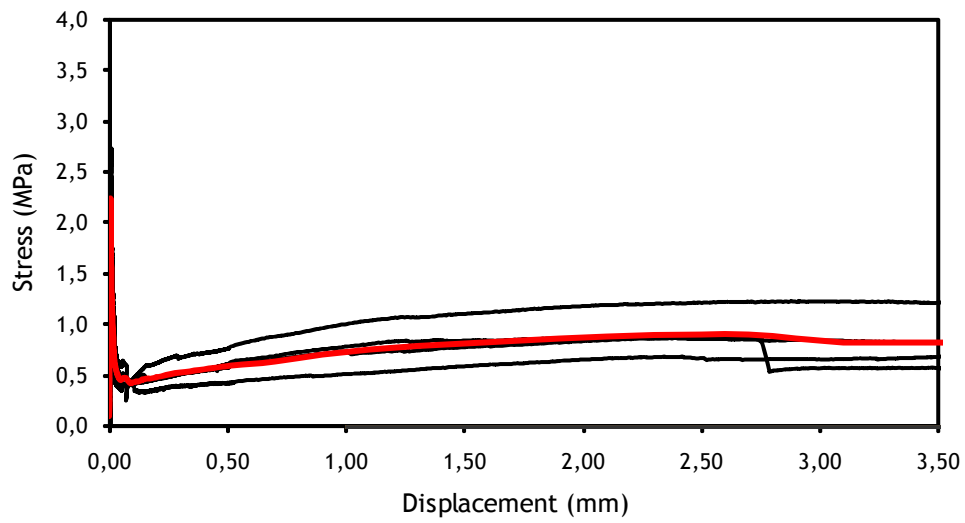
<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0,050	0,474	0,057
0,300	0,525	0,177
0,500	0,596	0,288
2,000	0,883	1,455
3,500	0,819	2,743
6,000	0,615	4,664



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	2,351	0,000
Second peak (S ₂)	2,855	0,921	2,177
Last value (S ₃)	33,678	0,221	12,360

$\delta_1 = 0,0054$ mm





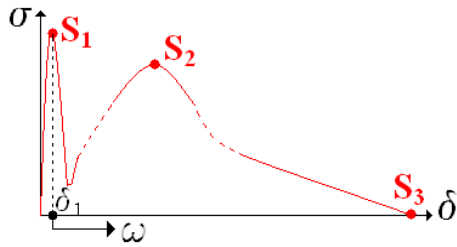
Single test

20 kg/m³ of steel fibers



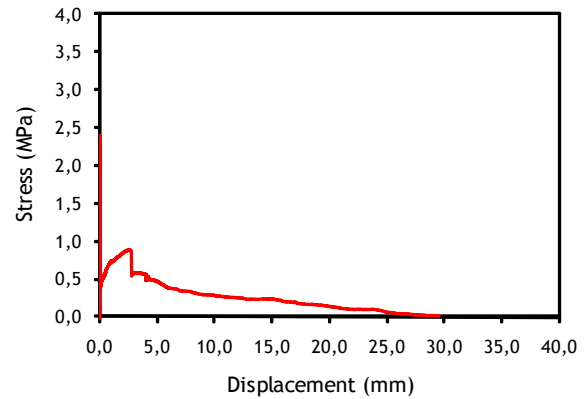
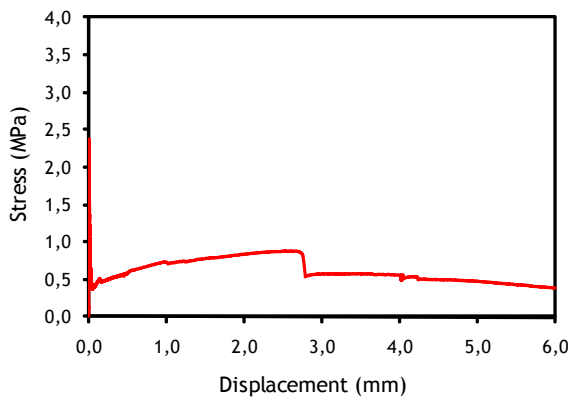
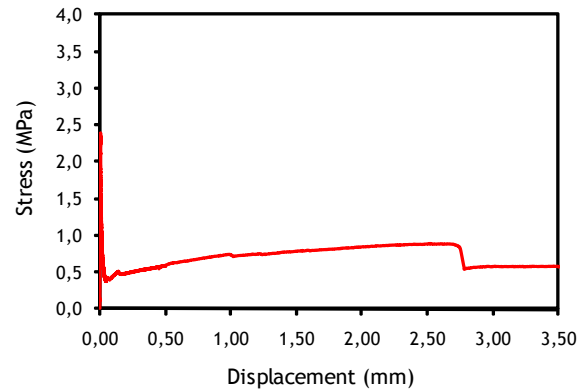
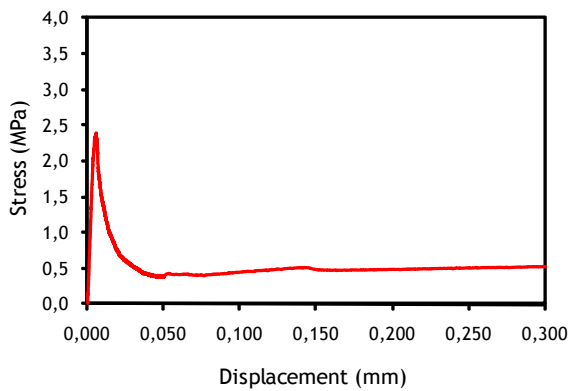
<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	20
Specimen number	1
Notation	A20-1
<i>Number of fibers at the cracked section</i>	
28	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0,050	0,407	0,056
0,300	0,516	0,174
0,500	0,584	0,284
2,000	0,835	1,392
3,500	0,570	2,466
6,000	0,383	3,772



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	2,385	0,000
Second peak (S ₂)	2,514	0,881	1,837
Last value (S ₃)	29,431	0,221	8,048

δ₁ = 0,0055 mm



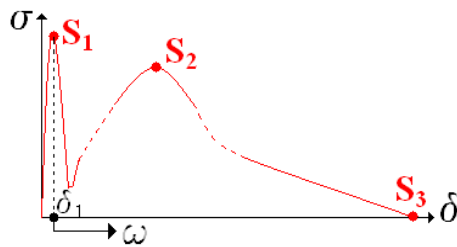
Single test

20 kg/m³ of steel fibers



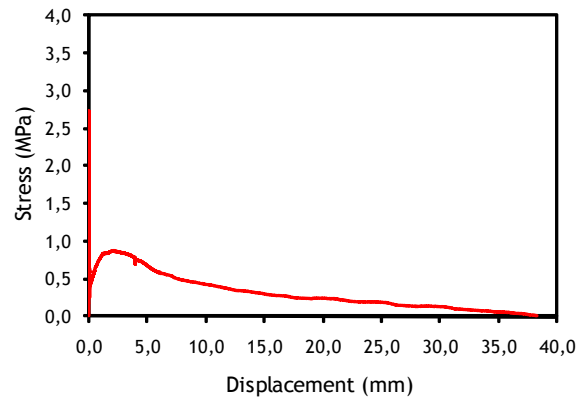
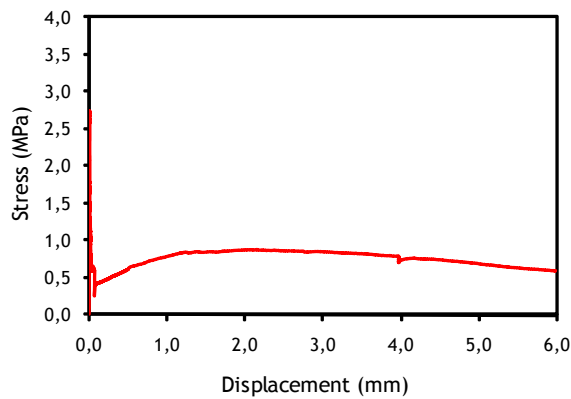
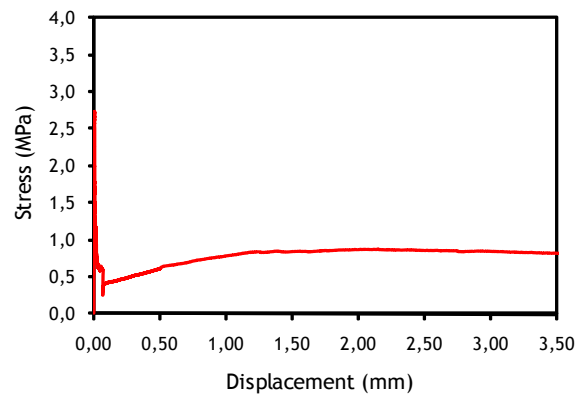
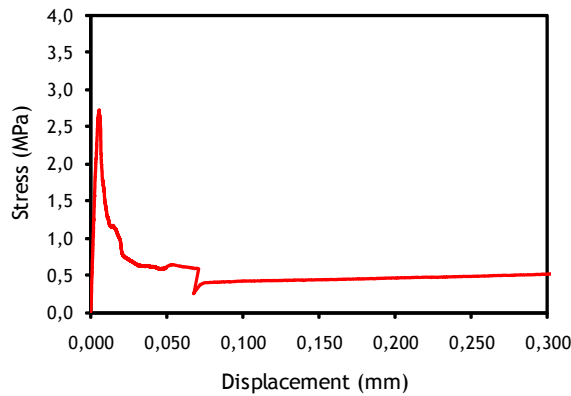
<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	20
Specimen number	2
Notation	A20-2
<i>Number of fibers at the cracked section</i>	
31	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0,050	0,634	0,064
0,300	0,520	0,184
0,500	0,622	0,296
2,000	0,872	1,493
3,500	0,821	2,768
6,000	0,593	4,624



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	2,733	0,000
Second peak (S ₂)	2,137	0,878	1,616
Last value (S ₃)	38,239	0,221	12,396

$\delta_1 = 0,0056 \text{ mm}$



Single test

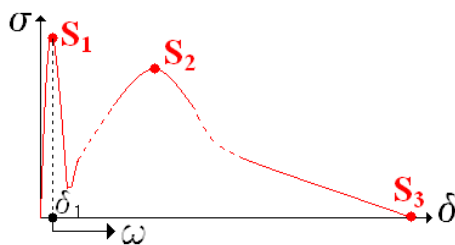
20 kg/m³ of steel fibers



<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	20
Specimen number	3
Notation	A20-3

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

<i>Number of fibers at the cracked section</i>
38

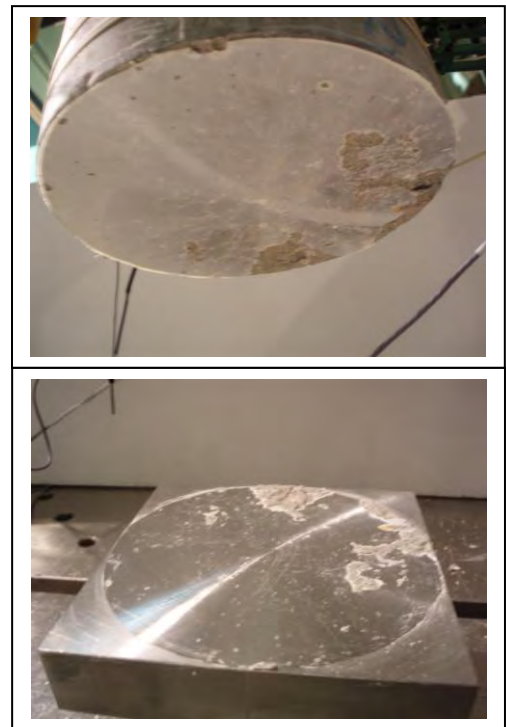
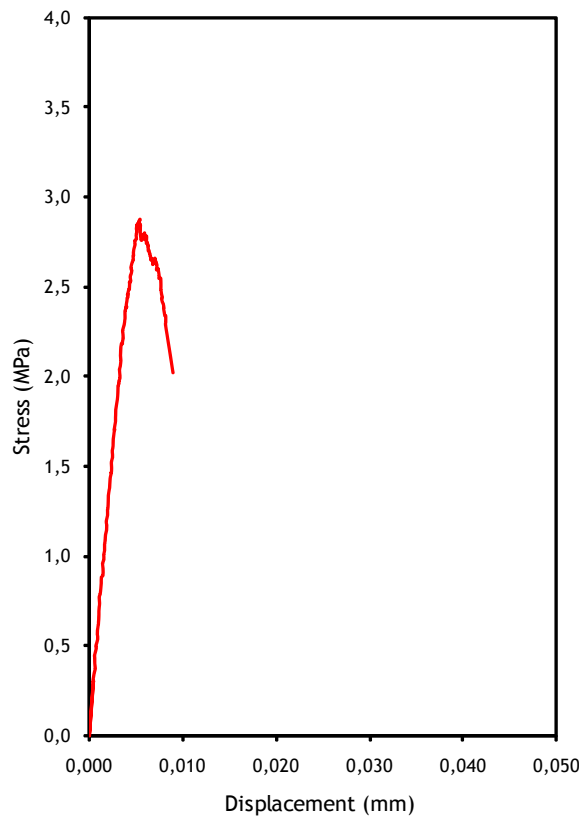


<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	2,871	0,000

Comments:

$\delta_1 = 0,0054 \text{ mm}$

Test failed.
 Detachment of the steel plate and the bottom surface of the specimen.
 The reason for this problem should have been insufficient powder in the glue mixture.



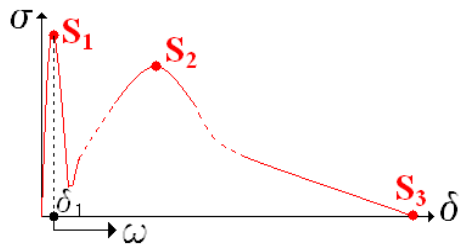
Single test

20 kg/m³ of steel fibers



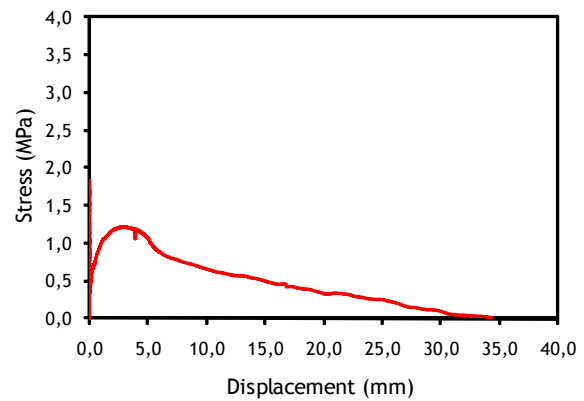
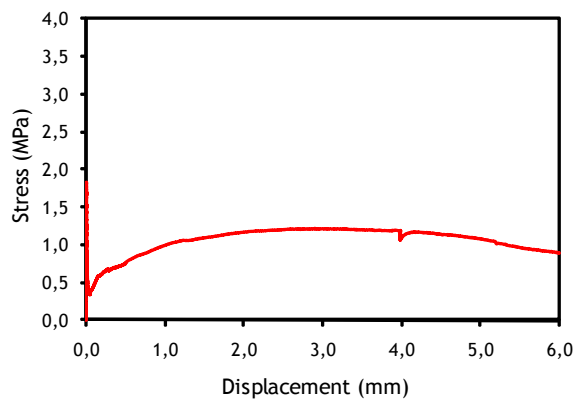
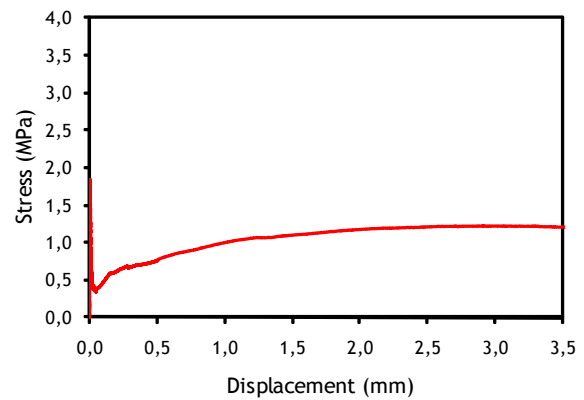
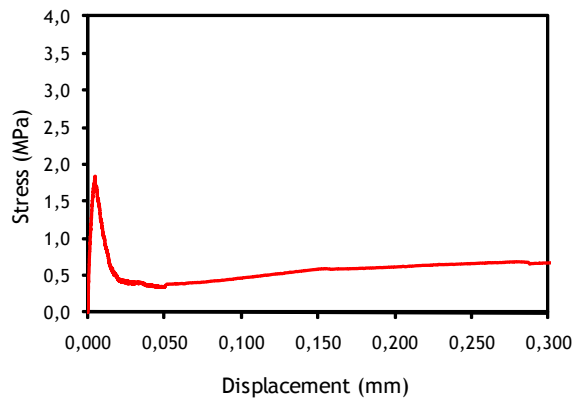
<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	20
Specimen number	4
Notation	A20-4
<i>Number of fibers at the cracked section</i>	
38	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0,050	0,366	0,045
0,300	0,672	0,189
0,500	0,757	0,331
2,000	1,174	1,874
3,500	1,205	3,689
6,000	0,885	6,515



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	1,839	0,000
Second peak (S ₂)	2,903	1,225	2,964
Last value (S ₃)	34,265	0,221	17,164

$\delta_1 = 0,0048 \text{ mm}$



Single test

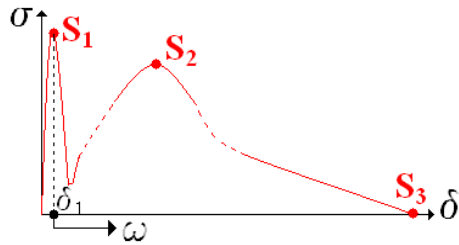
20 kg/m³ of steel fibers



Characteristics	
Concrete type	A
Fibers (kg/m ³)	20
Specimen number	5
Notation	A20-5

Reference values		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

Number of fibers at the cracked section
37

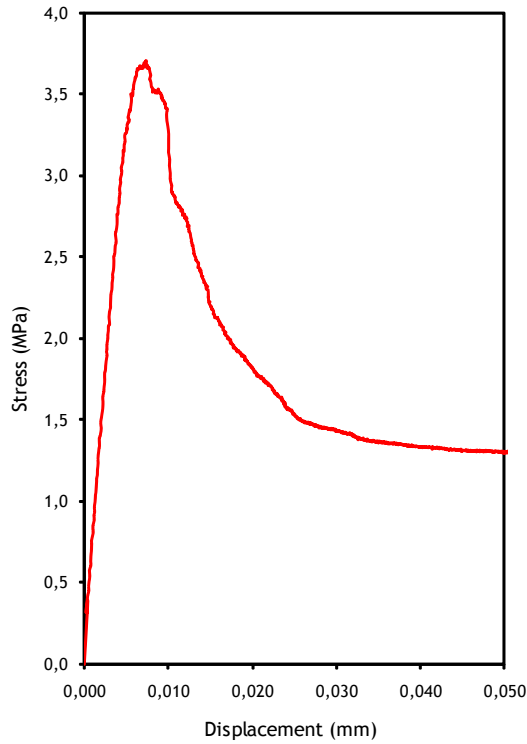


Significant values			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	3,700	0,000

δ₁ = 0,0074 mm

Comments:

Test stopped at δ=0.050mm due to unstable control when the displacement rate changed from 0.005mm/min to 0.100mm/min.



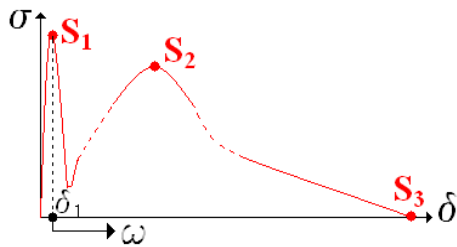
Single test

20 kg/m³ of steel fibers



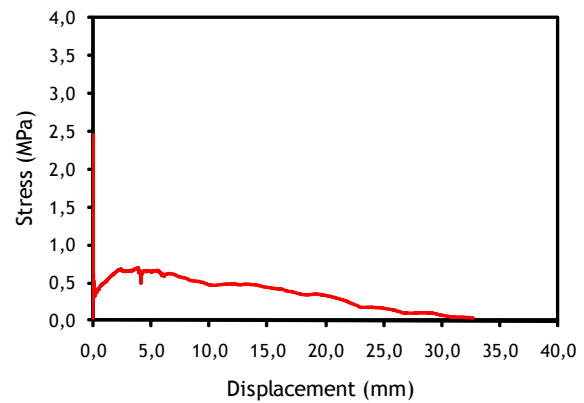
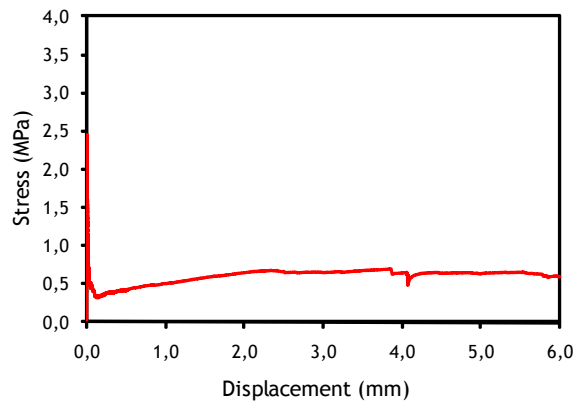
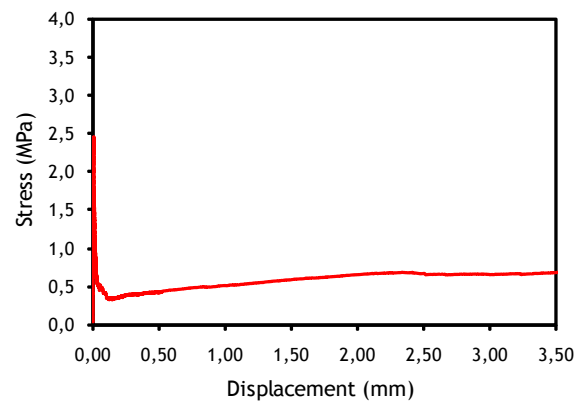
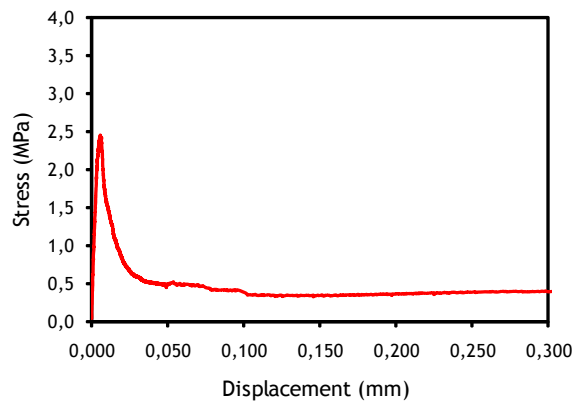
<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	20
Specimen number	6
Notation	A20-6
<i>Number of fibers at the cracked section</i>	
31	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0,050	0,489	0,064
0,300	0,392	0,160
0,500	0,422	0,242
2,000	0,651	1,060
3,500	0,678	2,050
6,000	0,599	3,744



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	2,448	0,000
Second peak (S ₂)	3,844	0,702	2,292
Last value (S ₃)	32,757	0,221	11,832

$\delta_1 = 0,0056 \text{ mm}$



A1.4 SERIE A40

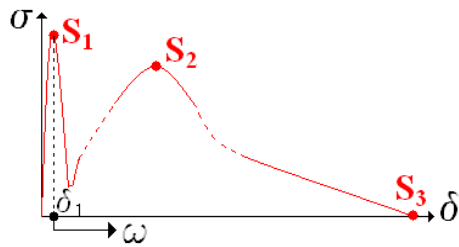
Average results

40 kg/m³ of steel fibers



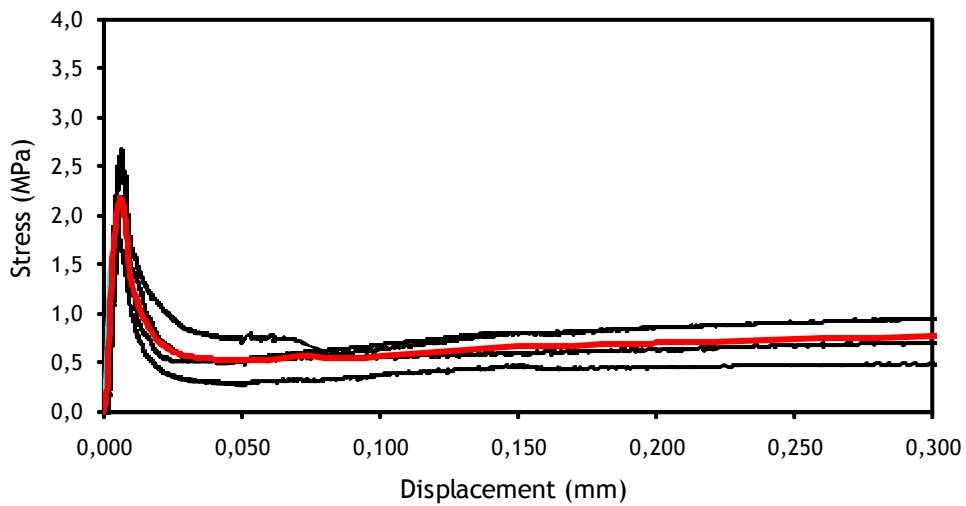
<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	40
Number of valid tests	4
Notation	A40
<i>Number of fibers at the cracked section</i>	
57	

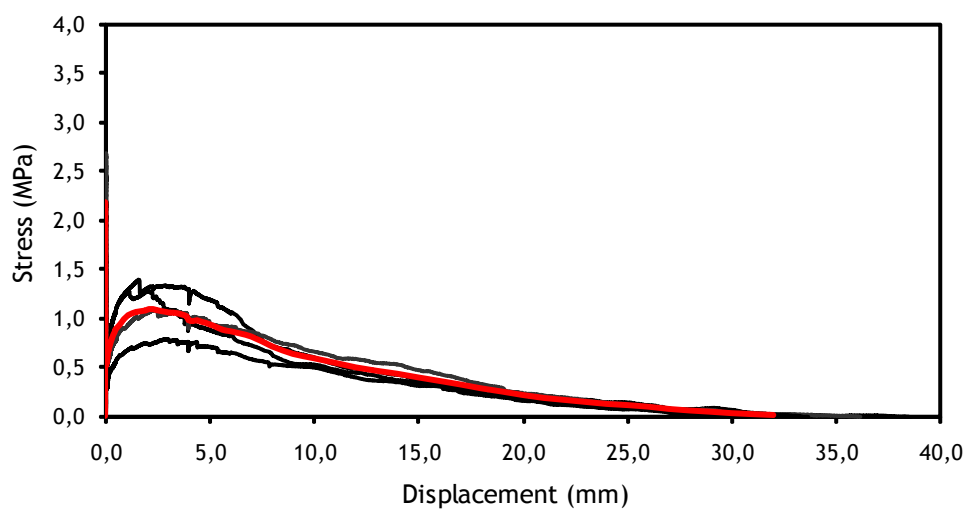
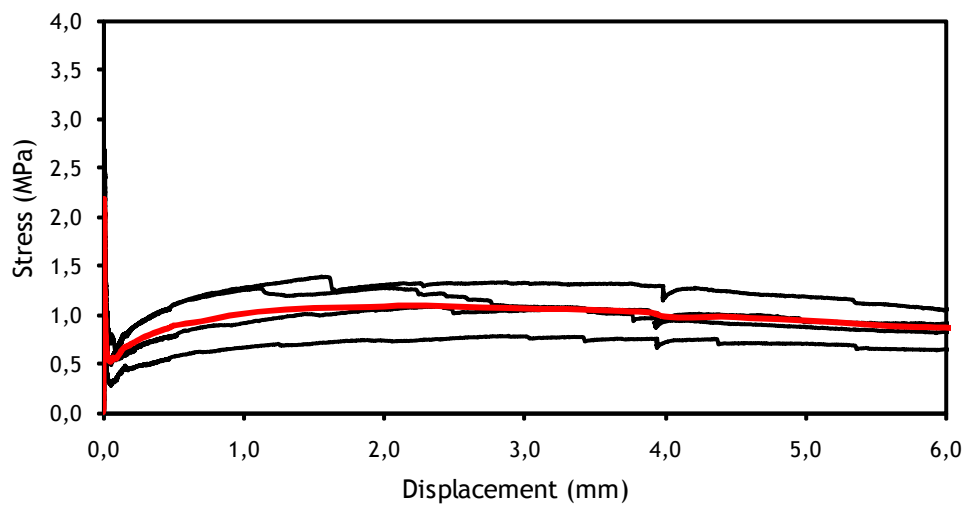
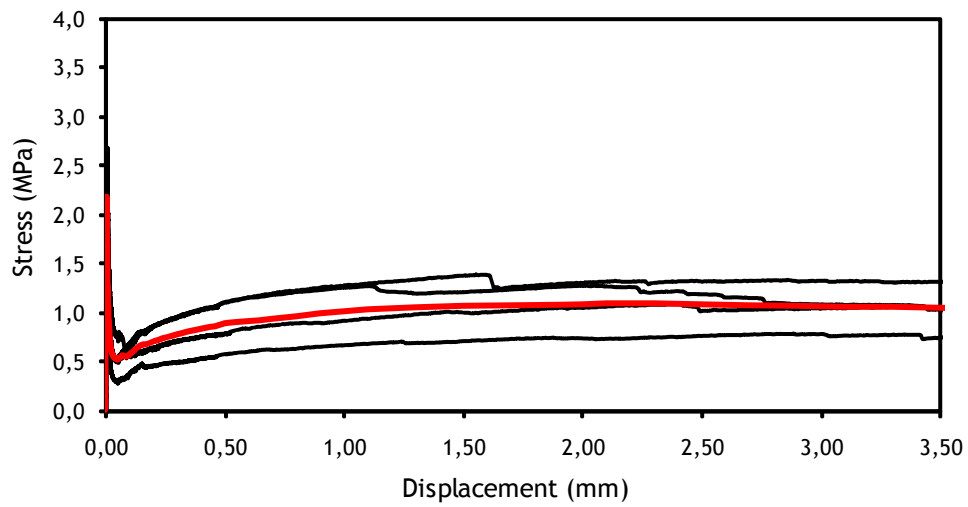
<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0,050	0,545	0,060
0,300	0,789	0,247
0,500	0,902	0,415
2,000	1,098	1,974
3,500	1,042	3,591
6,000	0,865	6,149



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	2,355	0,000
Second peak (S ₂)	2,196	1,144	2,099
Last value (S ₃)	30,921	0,221	13,846

δ₁ = 0,0058 mm





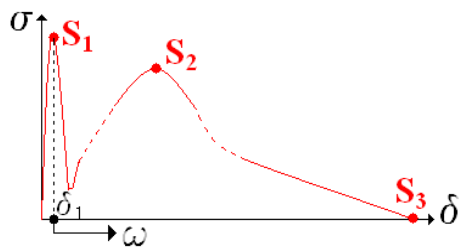
Single test

40 kg/m³ of steel fibers



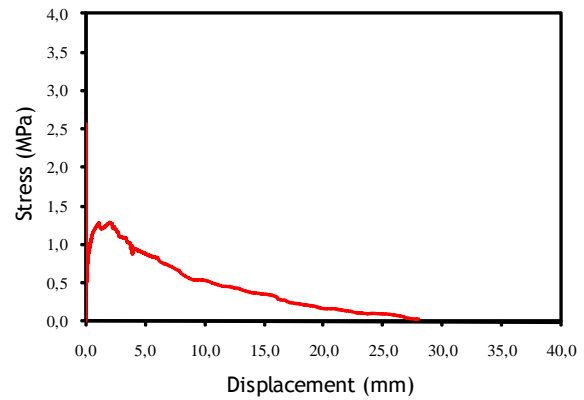
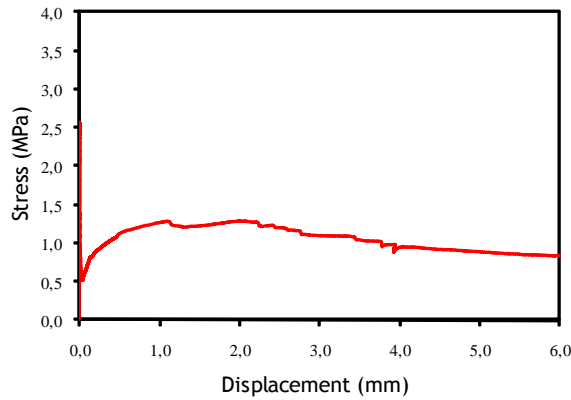
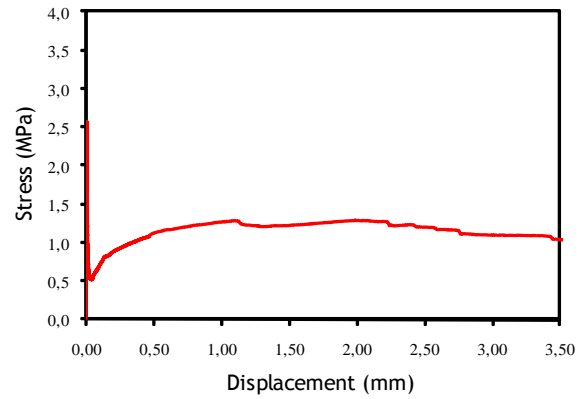
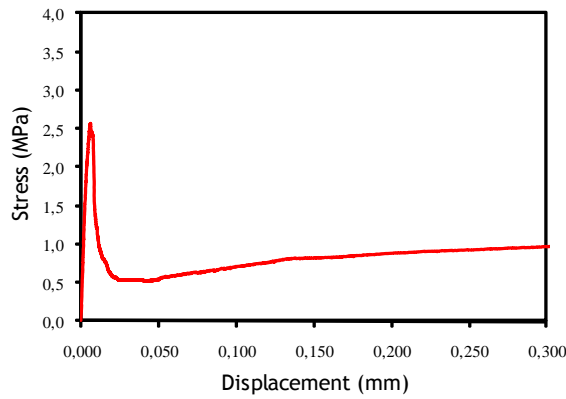
Characteristics	
Concrete type	A
Fibers (kg/m ³)	40
Specimen number	1
Notation	A40-1
Number of fibers at the cracked section	
57	

Reference values		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0,050	0,569	0,052
0,300	0,964	0,259
0,500	1,119	0,462
2,000	1,278	2,297
3,500	1,030	4,025
6,000	0,830	6,386



Significant values			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	2,563	0,000
Second peak (S ₂)	1,978	1,284	2,282
Last value (S ₃)	28,027	0,221	13,199

δ₁ = 0,0063 mm



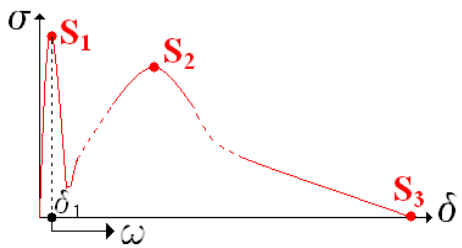
Single test

40 kg/m³ of steel fibers



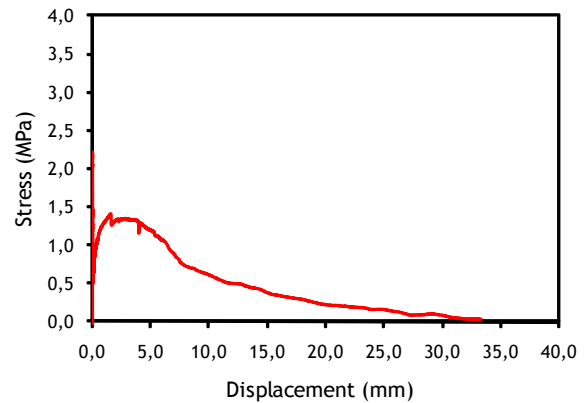
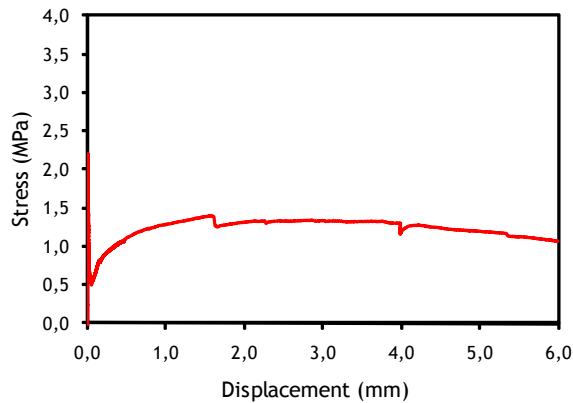
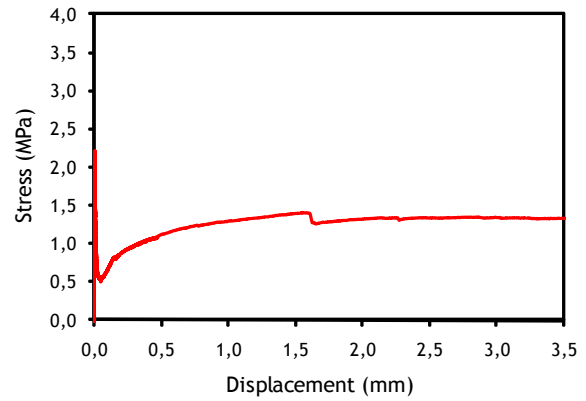
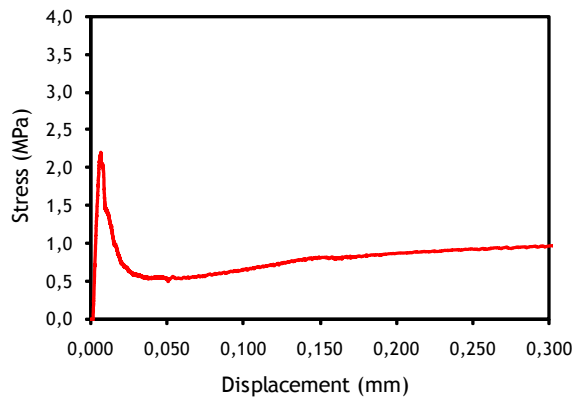
<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	40
Specimen number	2
Notation	A40-2
<i>Number of fibers at the cracked section</i>	
63	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0,050	0,543	0,061
0,300	0,972	0,272
0,500	1,117	0,483
2,000	1,317	2,409
3,500	1,326	4,404
6,000	1,062	7,611



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	2,206	0,000
Second peak (S ₂)	1,539	1,401	1,824
Last value (S ₃)	33,329	0,221	16,099

δ₁ = 0,0065 mm



Single test

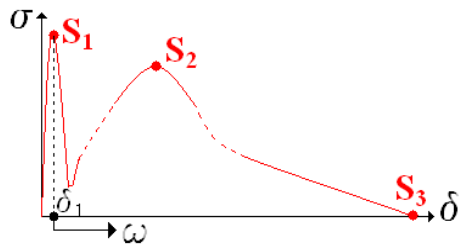
40 kg/m³ of steel fibers



Characteristics	
Concrete type	A
Fibers (kg/m ³)	40
Specimen number	3
Notation	A40-3

Reference values		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

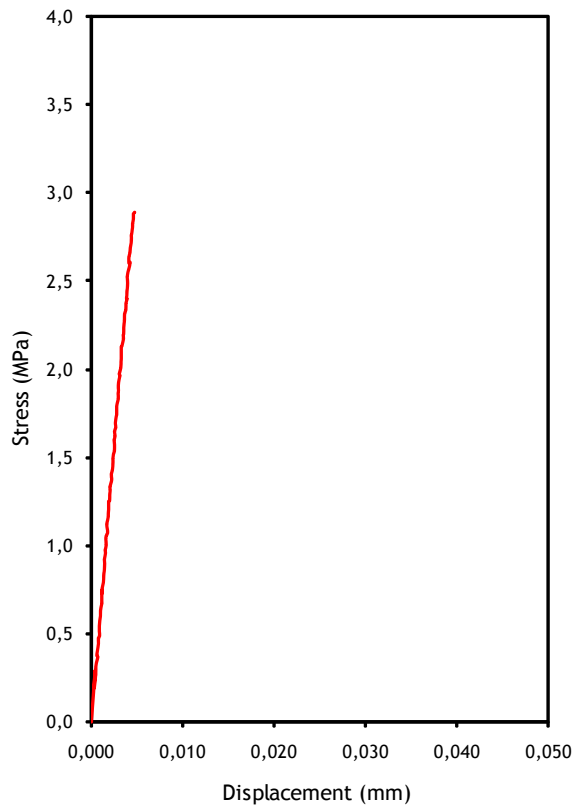
Number of fibers at the cracked section



Significant values			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]

Comments:

Test failed. Cracking occurred between the steel plate and the specimen's top surface because spreading of the adhesive was rather poor, returning a contact surface smaller than the notched cross-section.



Single test

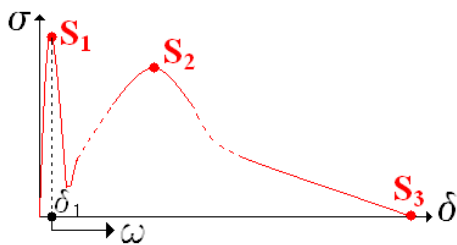
40 kg/m³ of steel fibers



<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	40
Specimen number	4
Notation	A40-4

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

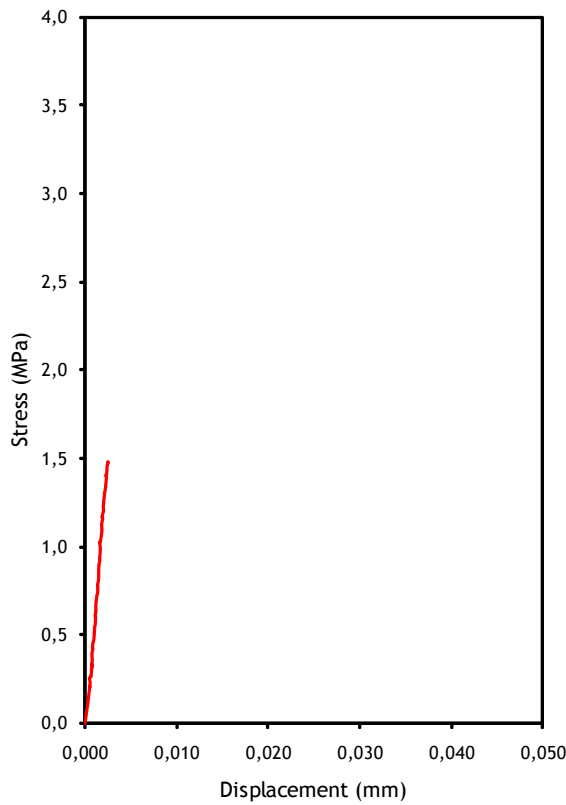
Number of fibers at the cracked section



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]

Comments:

Test failed. Cracking occurred between the steel plate and the specimen's top surface because spreading of the adhesive was rather poor, returning a contact surface smaller than the notched cross-section.



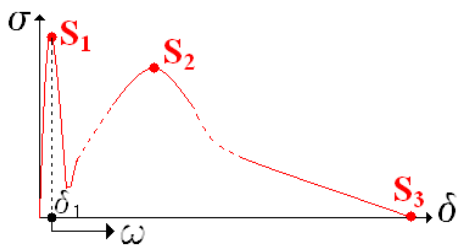
Single test

40 kg/m³ of steel fibers



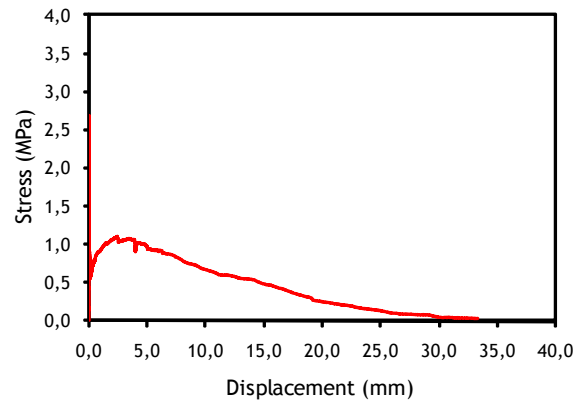
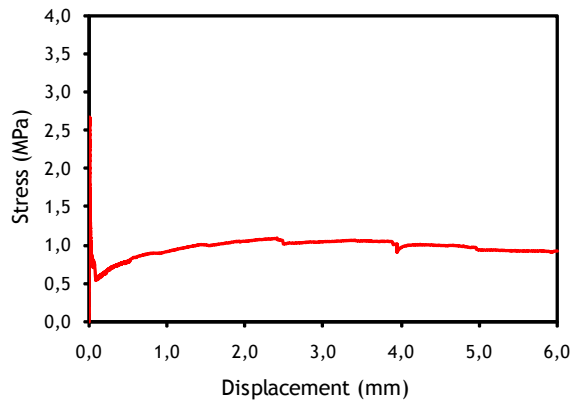
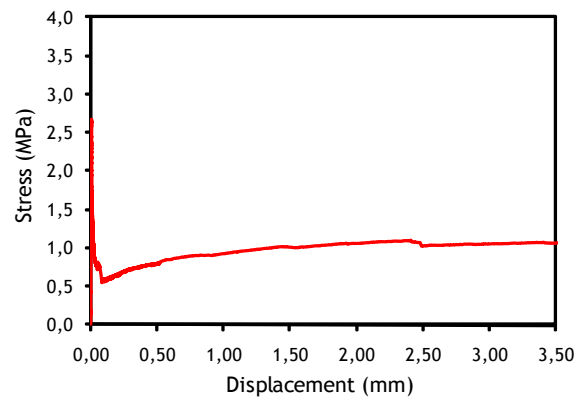
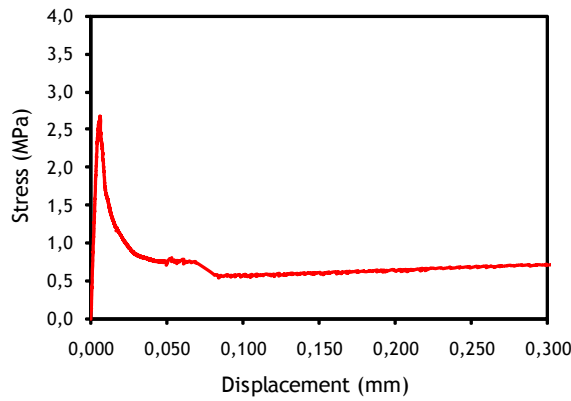
<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	40
Specimen number	5
Notation	A40-5
<i>Number of fibers at the cracked section</i>	
58	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0,050	0,767	0,090
0,300	0,719	0,296
0,500	0,792	0,451
2,000	1,058	1,889
3,500	1,061	3,483
6,000	0,917	6,189



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	2,681	0,000
Second peak (S ₂)	2,394	1,098	2,321
Last value (S ₃)	33,248	0,221	15,379

δ₁ = 0,0060 mm



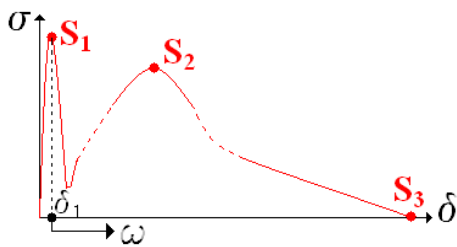
Single test

40 kg/m³ of steel fibers



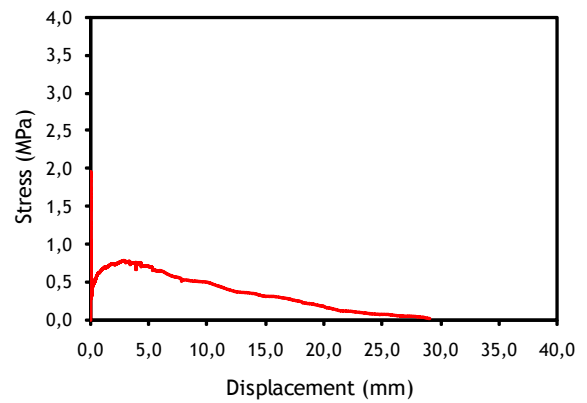
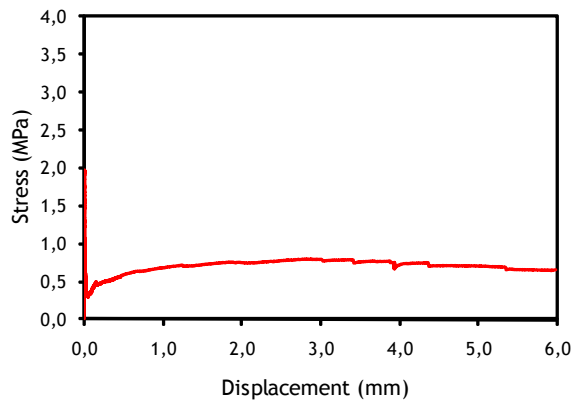
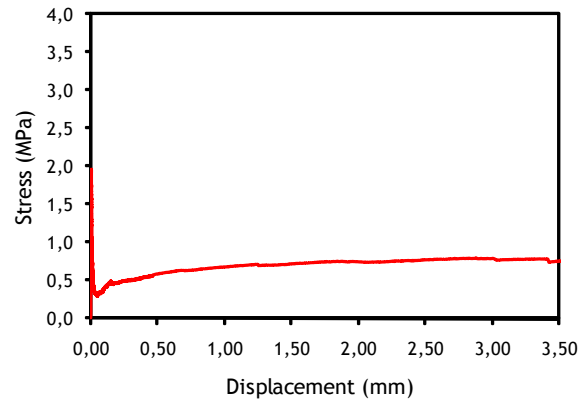
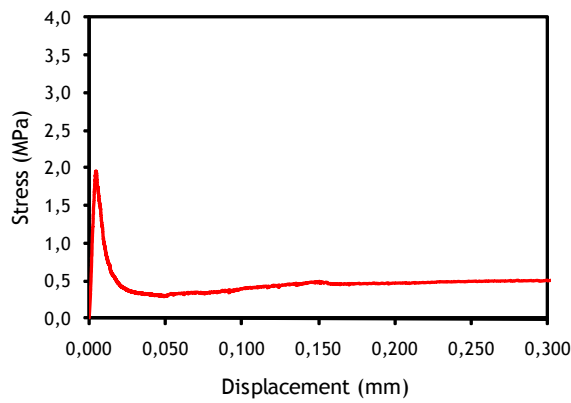
<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	40
Specimen number	6
Notation	A40-6
<i>Number of fibers at the cracked section</i>	
48	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0,050	0,302	0,039
0,300	0,502	0,159
0,500	0,582	0,265
2,000	0,742	1,300
3,500	0,751	2,451
6,000	0,652	4,410



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	1,968	0,000
Second peak (S ₂)	2,873	0,793	1,971
Last value (S ₃)	29,080	0,221	10,706

$\delta_1 = 0,0045 \text{ mm}$



A1.5 SERIE A60

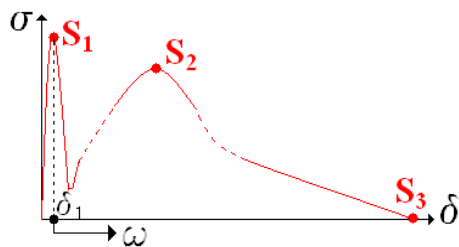
Average results

60 kg/m³ of steel fibers



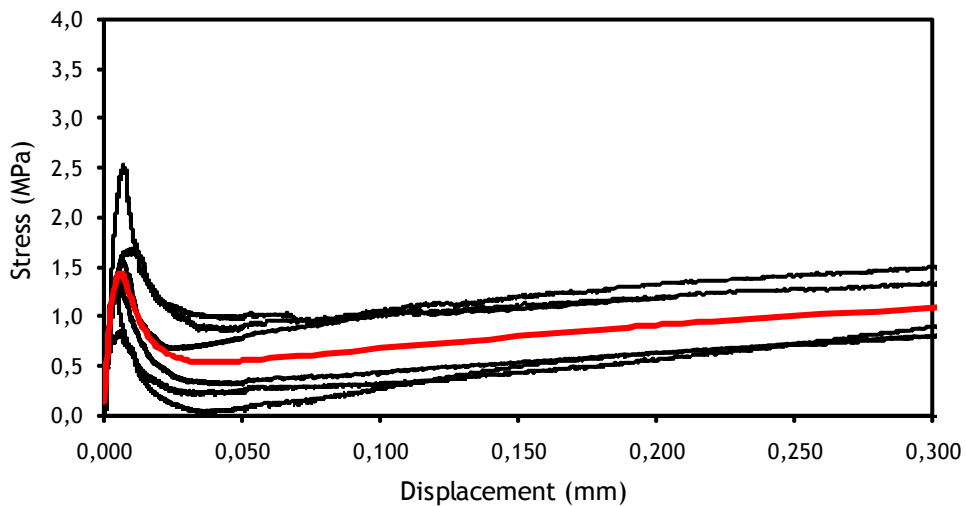
<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	60
Number of valid tests	6
Notation	A60
<i>Number of fibers at the cracked section</i>	
	95

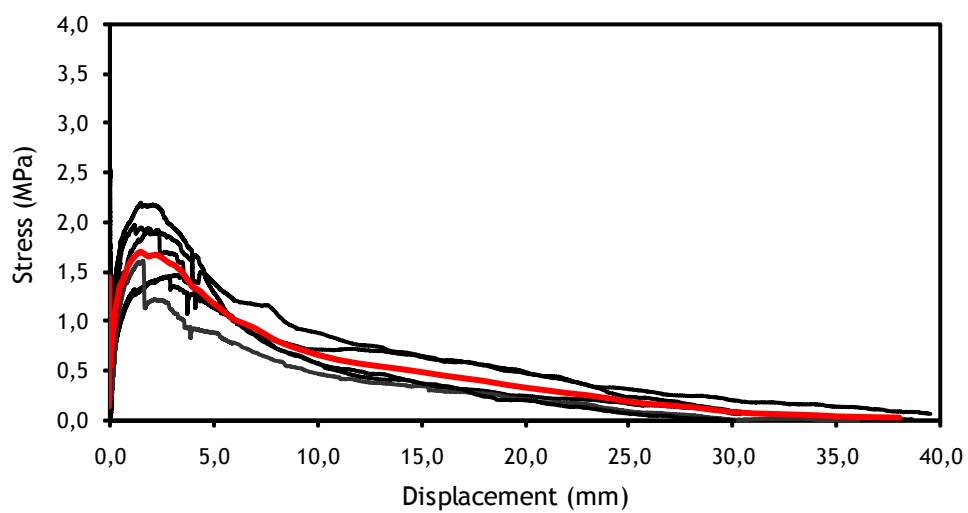
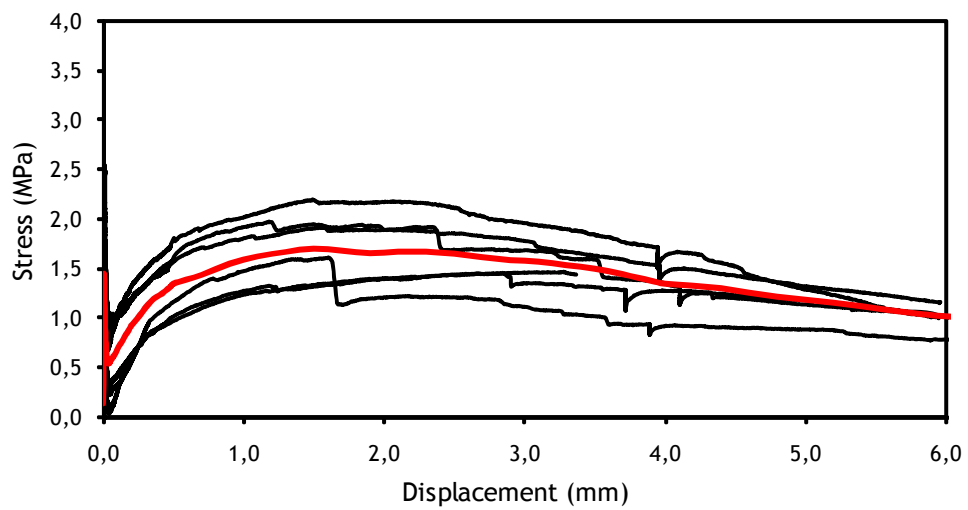
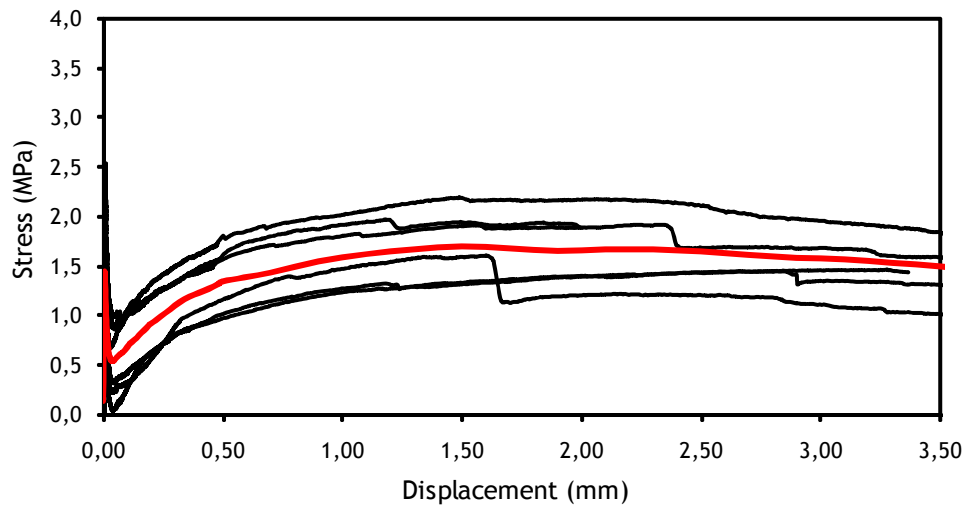
<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.591	0.055
0.300	1.127	0.279
0.500	1.362	0.525
2.000	1.660	2.951
3.500	1.469	5.508
6.000	0.996	8.799



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	1.588	0.000
Second peak (S ₂)	1.973	1.769	2.773
Last value (S ₃)	34.161	0.221	18.682

$\delta_1 = 0.0059$ mm





Single test

60 kg/m³ of steel fibers



Characteristics

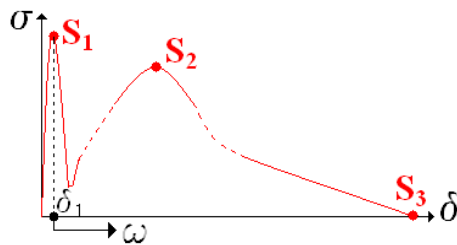
Concrete type	A
Fibers (kg/m ³)	60
Specimen number	1
Notation	A60-1

Number of fibers at the cracked section

89

Reference values

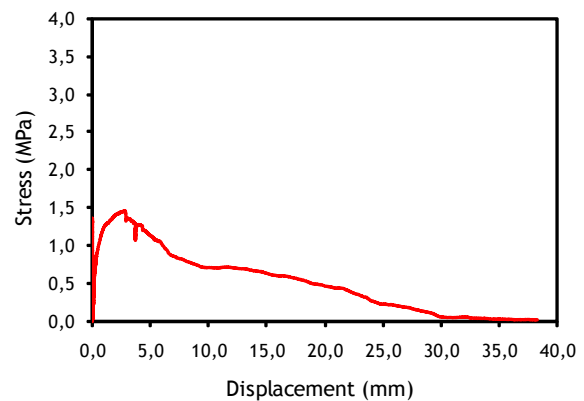
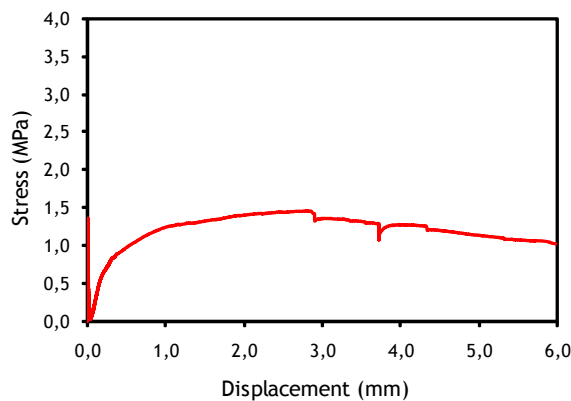
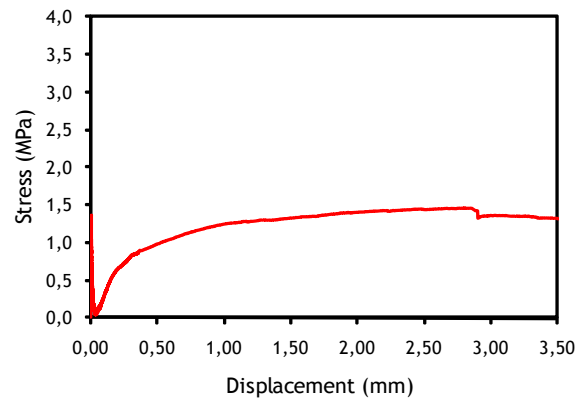
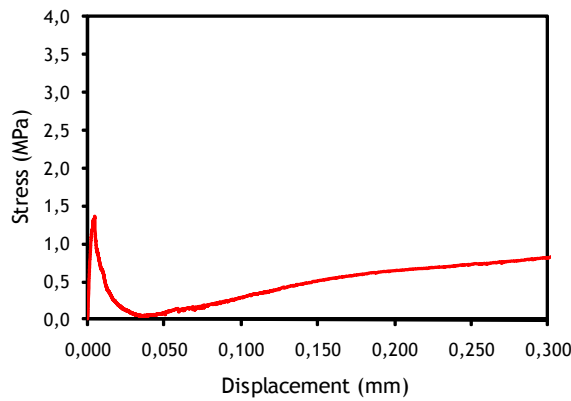
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0,050	0,090	0,016
0,300	0,824	0,153
0,500	0,979	0,331
2,000	1,399	2,216
3,500	1,312	4,312
6,000	1,018	7,410



Significant values

Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	1,359	0,000
Second peak (S ₂)	2,790	1,456	3,353
Last value (S ₃)	38,273	0,221	19,976

δ₁ = 0,0047 mm



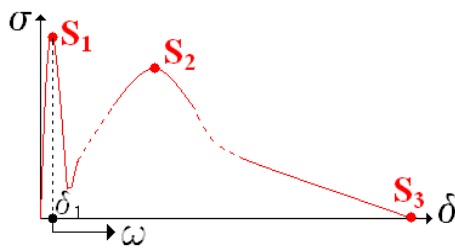
Single test

60 kg/m³ of steel fibers



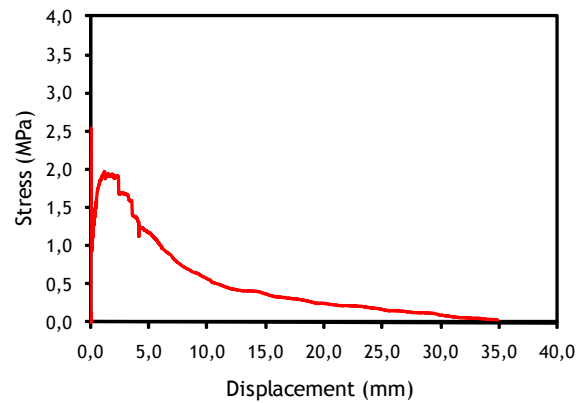
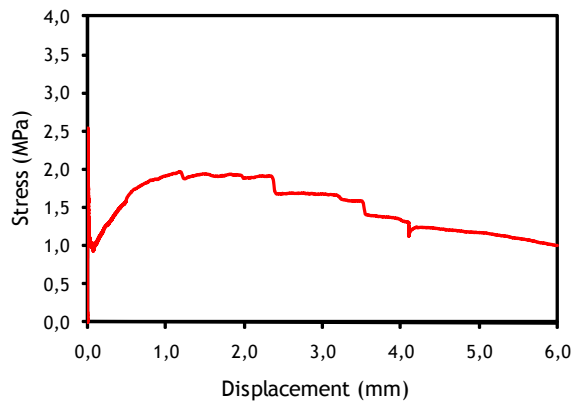
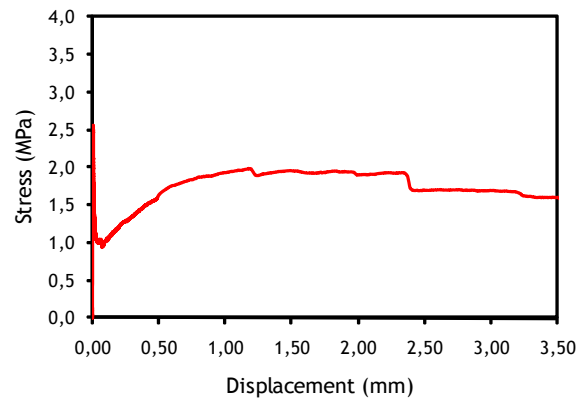
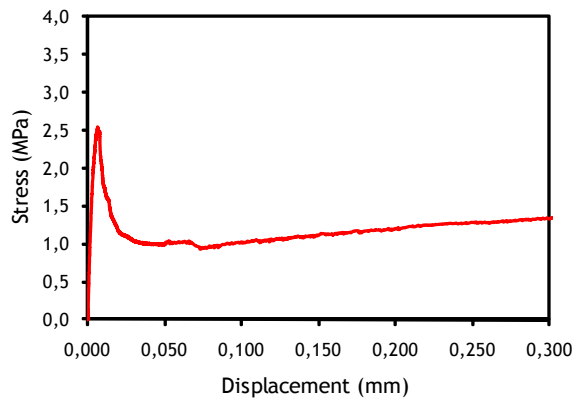
<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	60
Specimen number	2
Notation	A60-2
<i>Number of fibers at the cracked section</i>	
111	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0,050	1,021	0,092
0,300	1,351	0,389
0,500	1,643	0,679
2,000	1,904	3,518
3,500	1,563	6,110
6,000	1,005	9,445



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	2,549	0,000
Second peak (S ₂)	1,164	1,979	1,931
Last value (S ₃)	34,907	0,221	18,042

$\delta_1 = 0,0064 \text{ mm}$



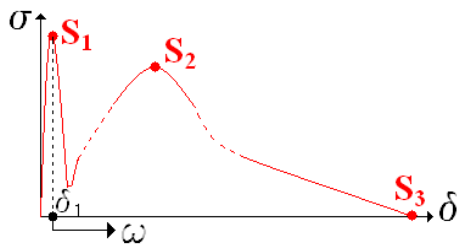
Single test

60 kg/m³ of steel fibers



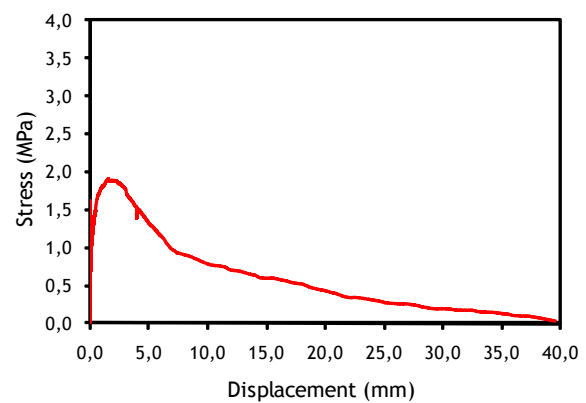
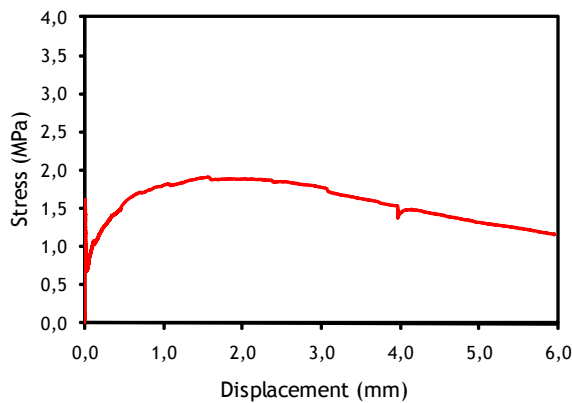
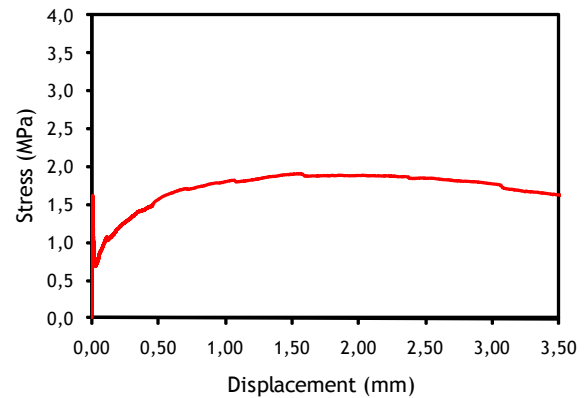
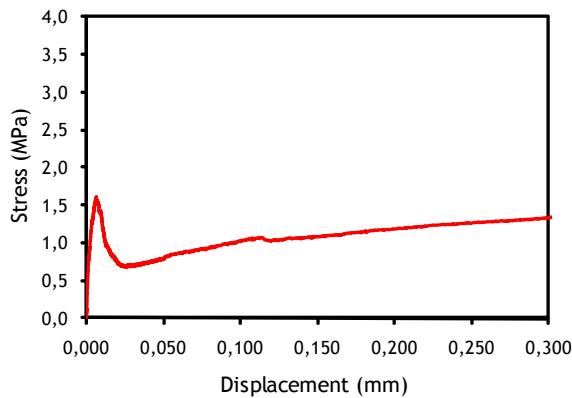
Characteristics	
Concrete type	A
Fibers (kg/m ³)	60
Specimen number	3
Notation	A60-3
Number of fibers at the cracked section	
82	

Reference values		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0,050	0,838	0,065
0,300	1,342	0,351
0,500	1,575	0,637
2,000	1,882	3,351
3,500	1,622	6,042
6,000	1,158	9,629



Significant values			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	1,615	0,000
Second peak (S ₂)	1,556	1,909	2,531
Last value (S ₃)	39,515	0,221	23,241

δ₁ = 0,0064 mm



Single test

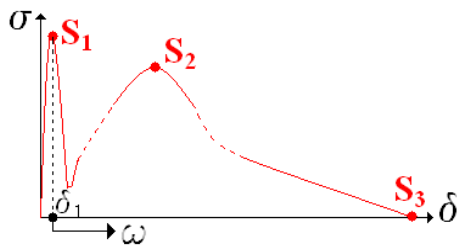
60 kg/m³ of steel fibers



<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	60
Specimen number	4
Notation	A60-4

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0,050	0,358	0,043
0,300	0,810	0,202
0,500	1,017	0,388
2,000	1,395	2,300

Number of fibers at the cracked section

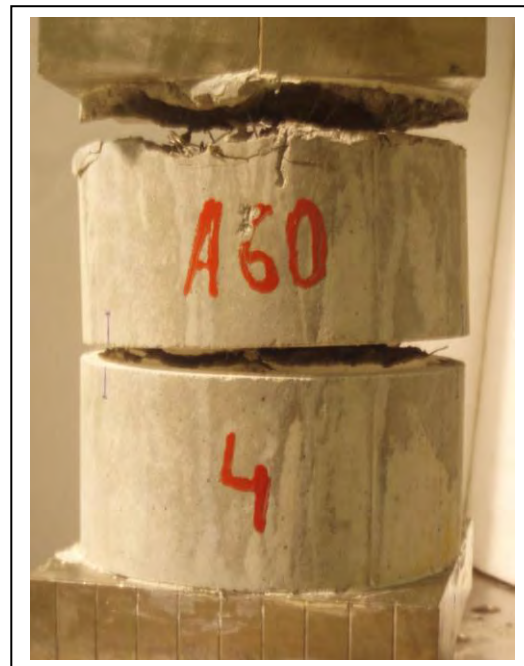
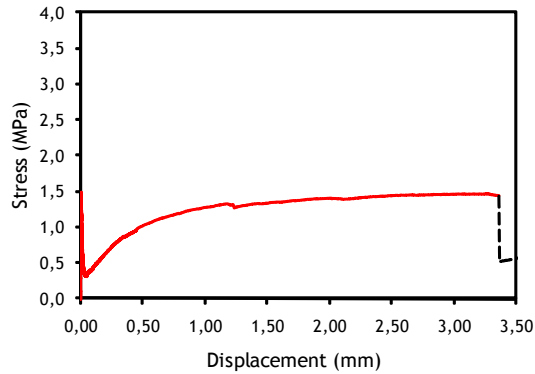
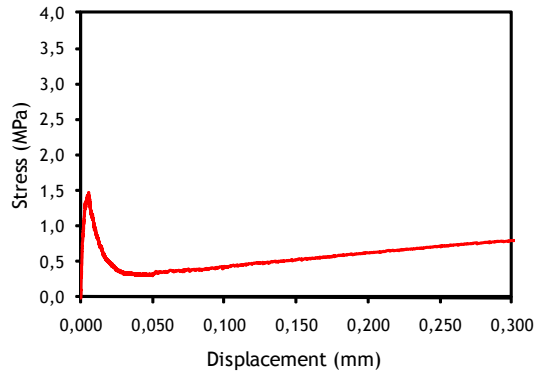


<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	1,478	0,000
Second peak (S ₂)	3,271	1,462	4,131

$\delta_1 = 0,0055 \text{ mm}$

Comments:

Test valid up to a crack width of 3.27 mm.
After this value the test results were affected by a sudden crack that emerged at the top of the specimen.



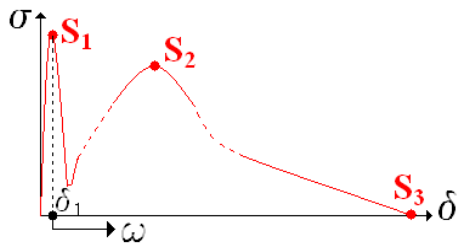
Single test

60 kg/m³ of steel fibers



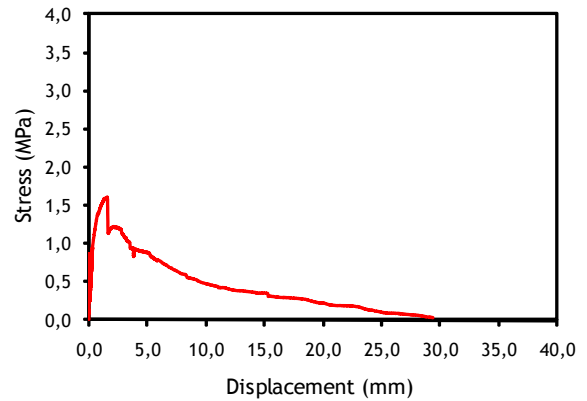
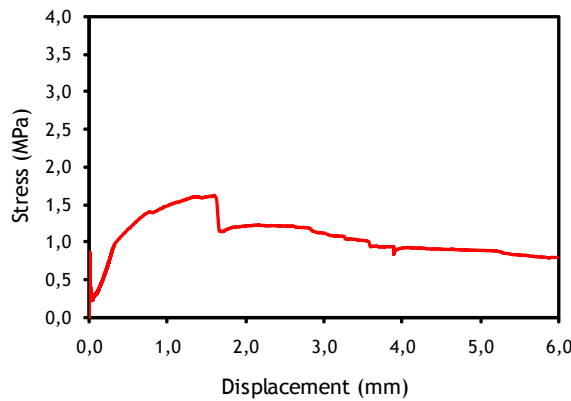
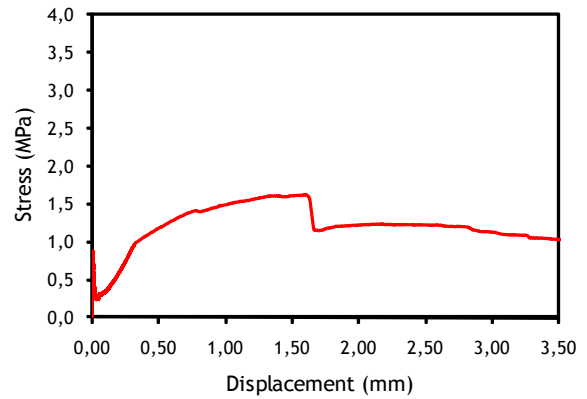
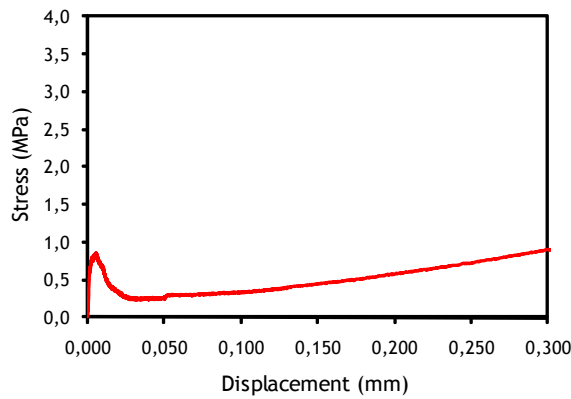
Characteristics	
Concrete type	A
Fibers (kg/m ³)	60
Specimen number	5
Notation	A60-5
Number of fibers at the cracked section	
79	

Reference values		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0,050	0,289	0,030
0,300	0,921	0,172
0,500	1,181	0,386
2,000	1,214	2,486
3,500	1,021	4,224
6,000	0,786	6,631



Significant values			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	0,869	0,000
Second peak (S ₂)	1,584	1,619	1,982
Last value (S ₃)	29,404	0,221	13,559

$\delta_1 = 0,0055 \text{ mm}$



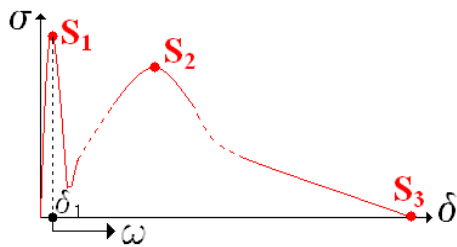
Single test

60 kg/m³ of steel fibers



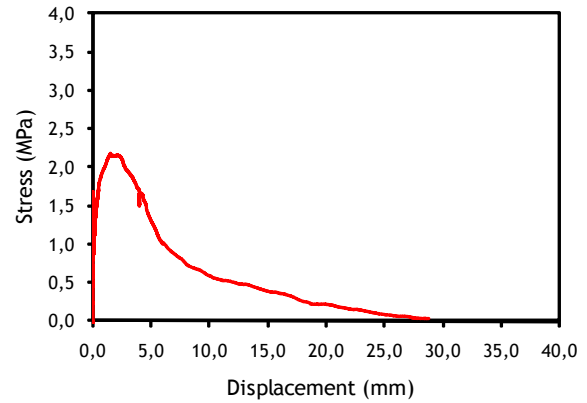
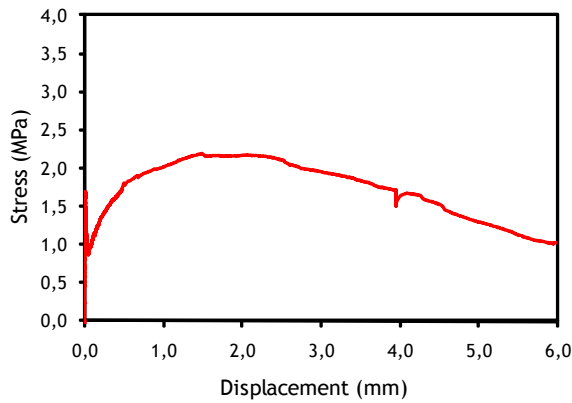
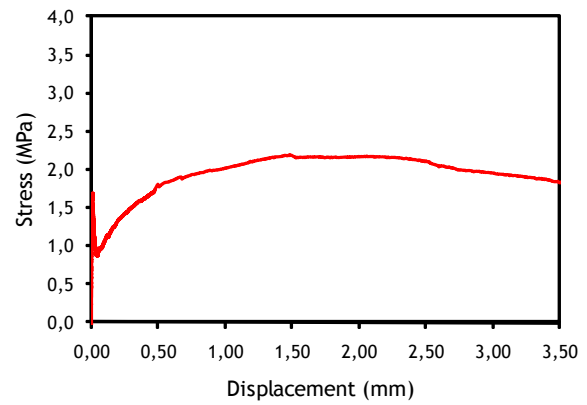
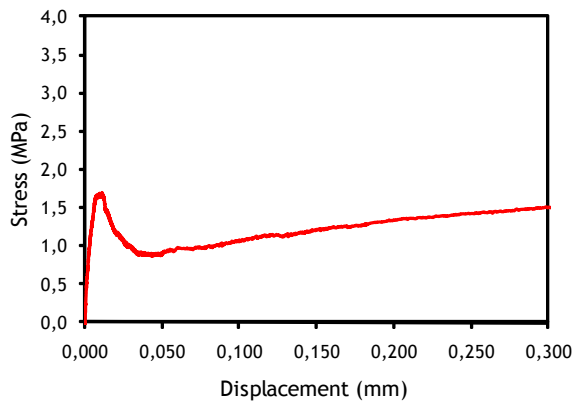
<i>Characteristics</i>	
Concrete type	A
Fibers (kg/m ³)	60
Specimen number	6
Notation	A60-6
<i>Number of fibers at the cracked section</i>	
113	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0,050	0,951	0,086
0,300	1,514	0,408
0,500	1,778	0,730
2,000	2,165	3,834
3,500	1,828	6,854
6,000	1,012	10,881



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0,000	1,657	0,000
Second peak (S ₂)	1,474	2,191	2,710
Last value (S ₃)	28,705	0,221	18,590

δ₁ = 0,0071 mm



A1.6 SERIE B0

Average results

0 kg/m³ of steel fibers



Characteristics

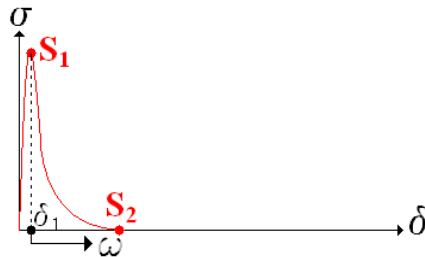
Concrete type	B
Fibers (kg/m ³)	0
Number of valid tests	5
Notation	B0

Reference values

Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

Number of fibers at the cracked section

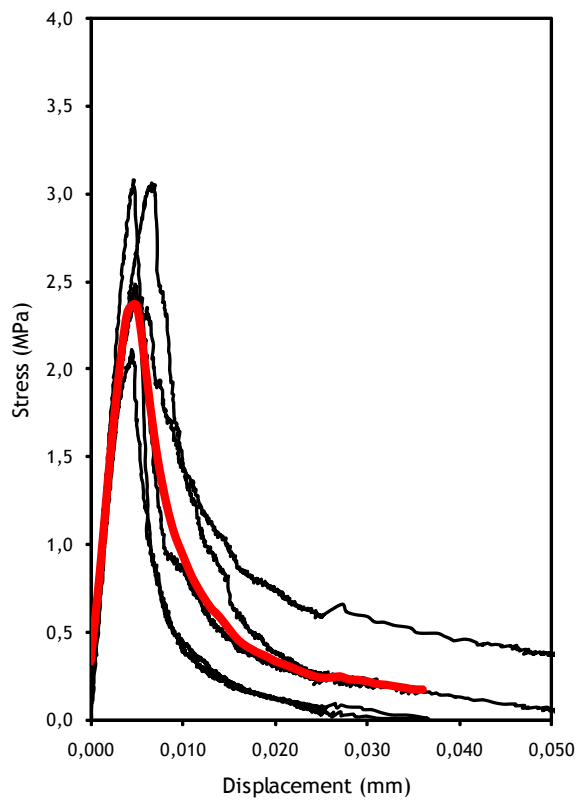
0



Significant values

Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	2.601	0.000
Last value (S ₂)	0.036	0.171	0.025

δ₁ = 0.0055 mm



Single test

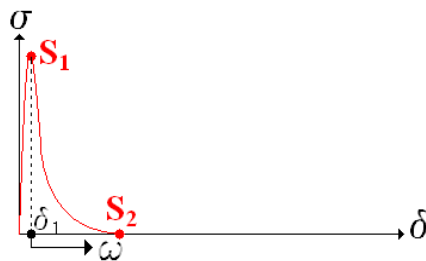
0 kg/m³ of steel fibers



Characteristics	
Concrete type	B
Fibers (kg/m ³)	0
Specimen number	1
Notation	B0-1

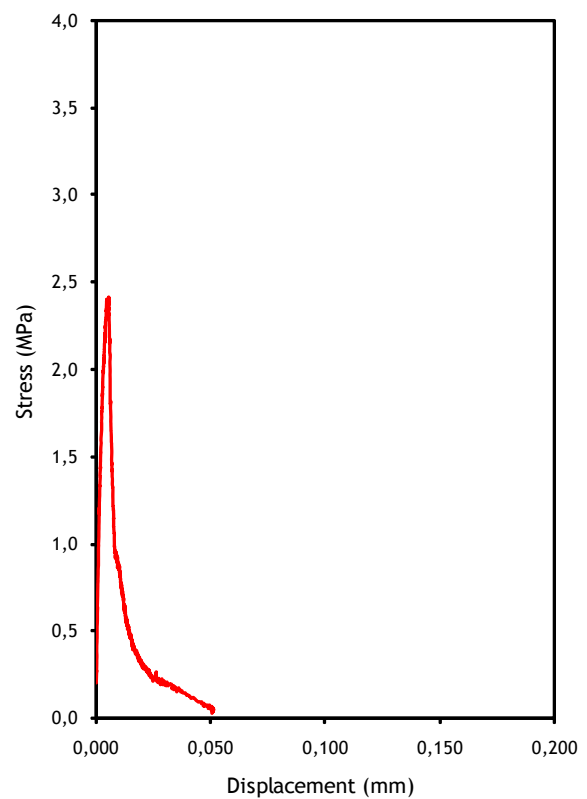
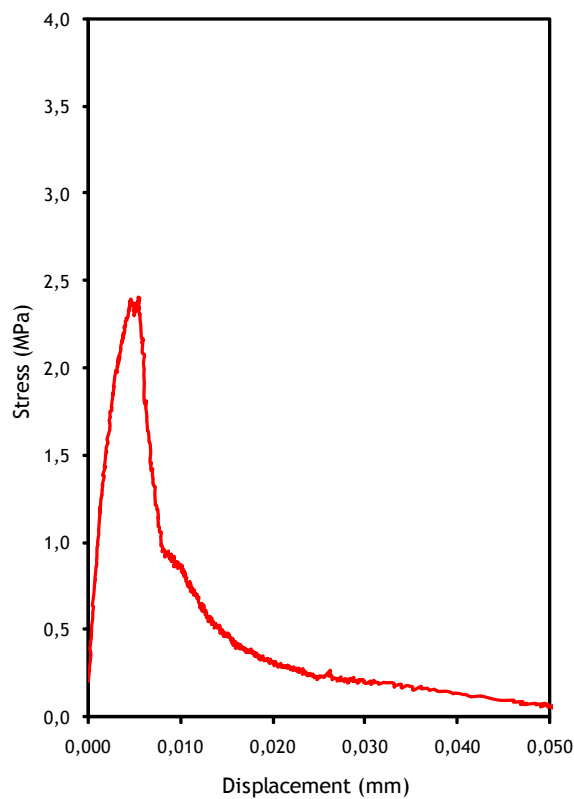
Reference values		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

Number of fibers at the cracked section
0



Significant values			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	2.409	0.000
Last value (S ₂)	0.045	0.057	0.025

$\delta_1 = 0.0059 \text{ mm}$



Single test

0 kg/m³ of steel fibers



Characteristics

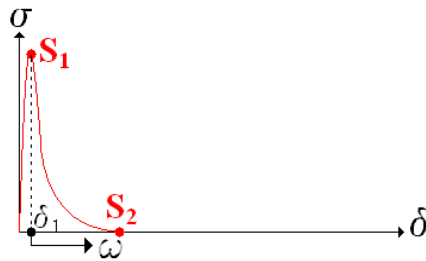
Concrete type	B
Fibers (kg/m ³)	0
Specimen number	2
Notation	B0-2

Reference values

Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.354	0.059

Number of fibers at the cracked section

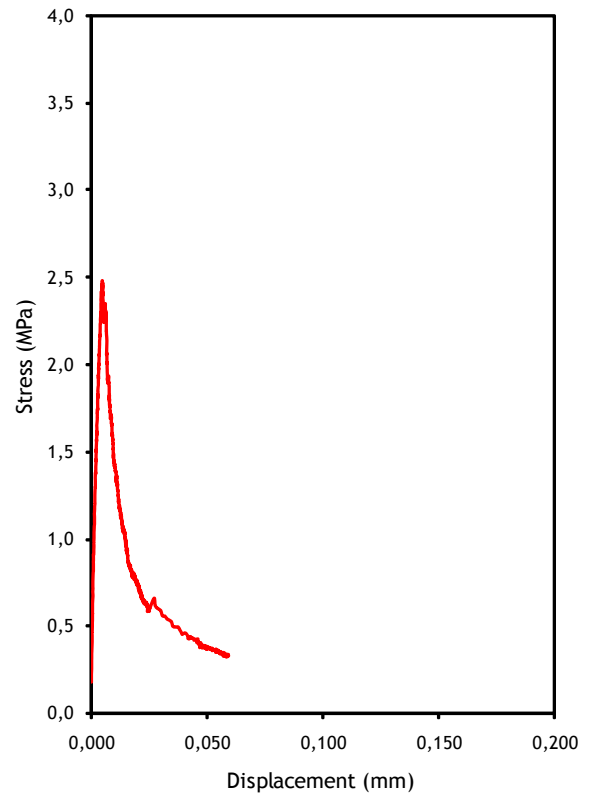
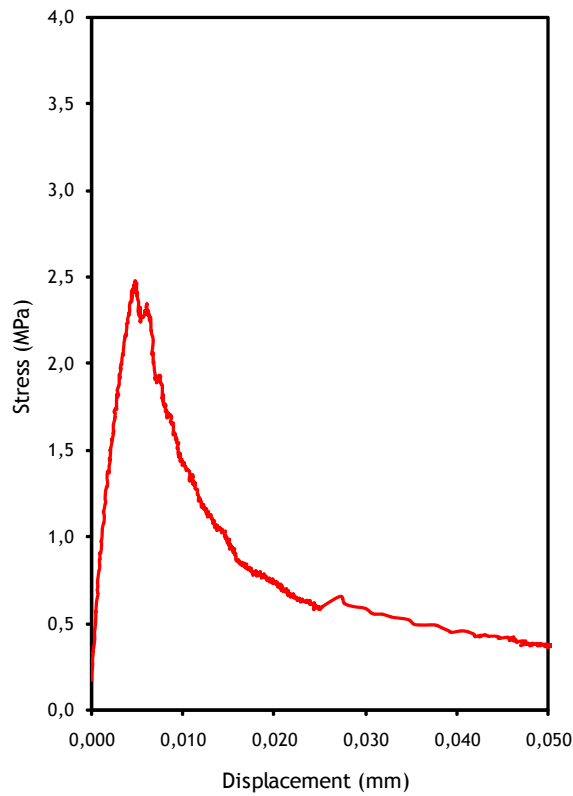
0



Significant values

Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	2.343	0.000
Last value (S ₂)	0.054	0.327	0.062

δ₁ = 0.0052 mm



Single test

0 kg/m³ of steel fibers



Characteristics

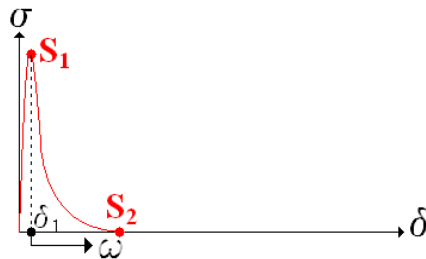
Concrete type	B
Fibers (kg/m ³)	0
Specimen number	3
Notation	B0-3

Reference values

Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

Number of fibers at the cracked section

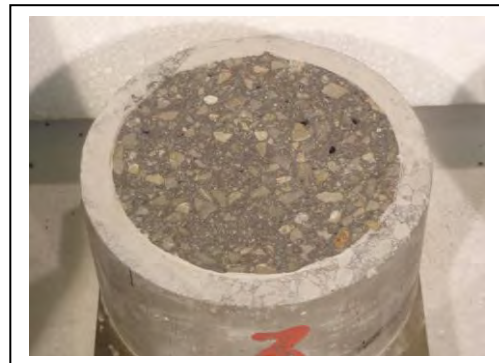
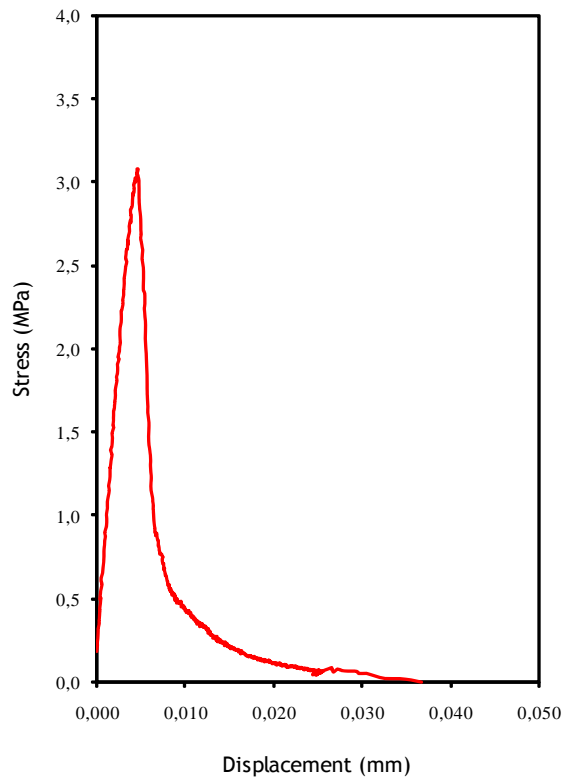
0



Significant values

Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	3.083	0.000
Last value (S ₂)	0.032	0.003	0.013

δ₁ = 0.0050 mm



Single test

0 kg/m³ of steel fibers



Characteristics

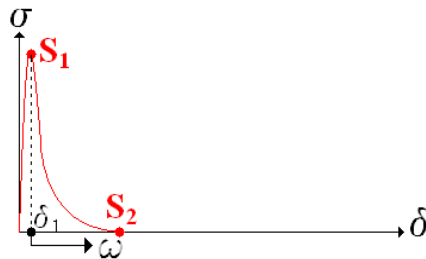
Concrete type	B
Fibers (kg/m ³)	0
Specimen number	4
Notation	B0-4

Reference values

Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

Number of fibers at the cracked section

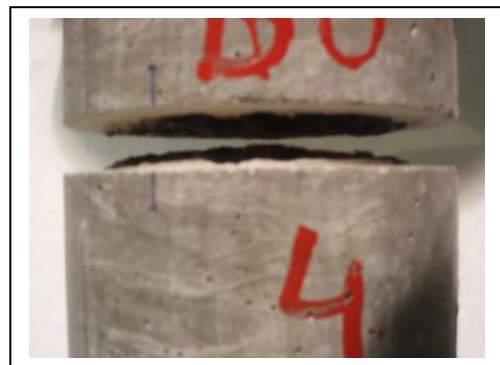
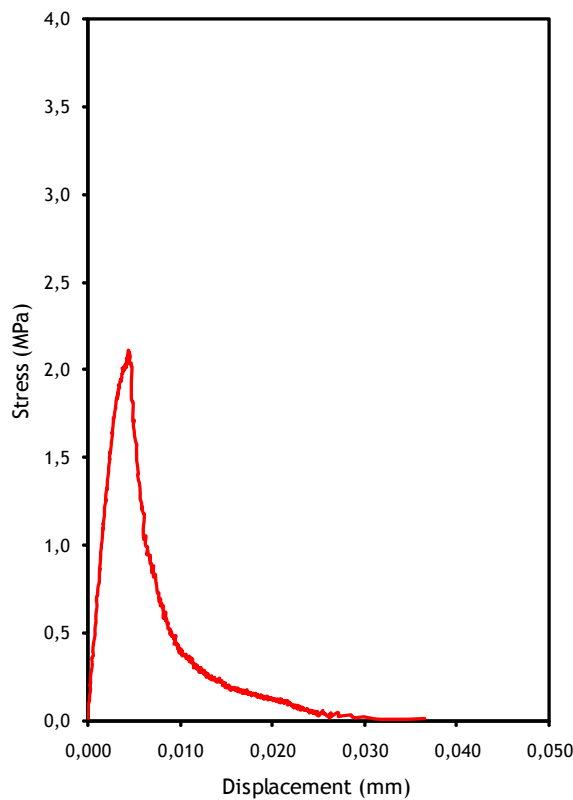
0



Significant values

Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	2.109	0.000
Last value (S ₂)	0.032	0.010	0.012

δ₁ = 0.0048 mm



Single test

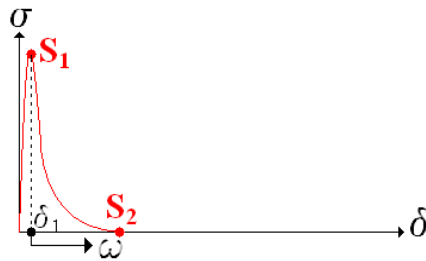
0 kg/m³ of steel fibers



<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	0
Specimen number	5
Notation	B0-5

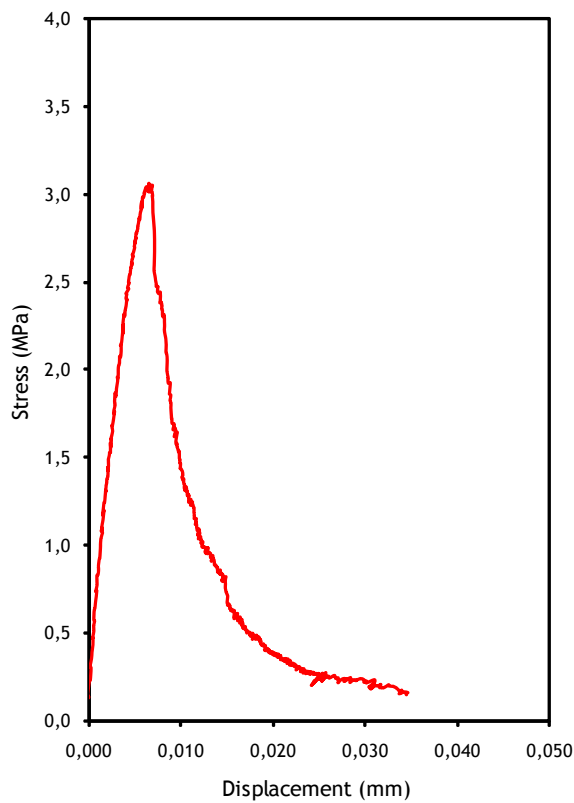
<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

<i>Number of fibers at the cracked section</i>
0



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	3.062	0.000
Last value (S ₂)	0.028	0.147	0.032

$\delta_1 = 0.0069 \text{ mm}$



Single test

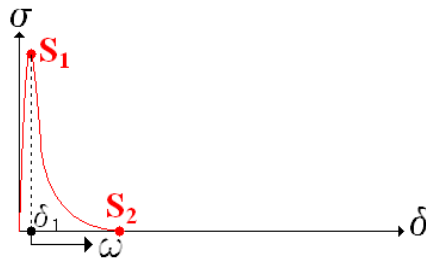
0 kg/m³ of steel fibers



<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	0
Specimen number	6
Notation	B0-6

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

<i>Number of fibers at the cracked section</i>
0



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]

Comments:

Test failed.
The extensometers were deficiently calibrated.

A1.7 SERIE B20

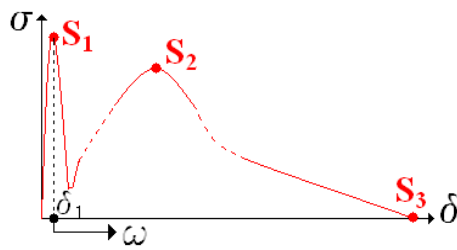
Average results

20 kg/m³ of steel fibers



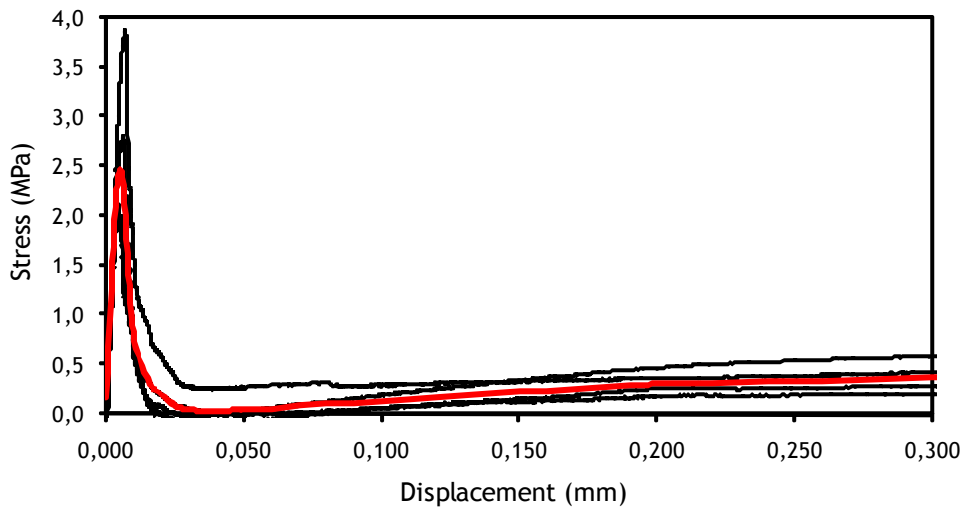
<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	20
Number of valid tests	4
Notation	B20
<i>Number of fibers at the cracked section</i>	
27	

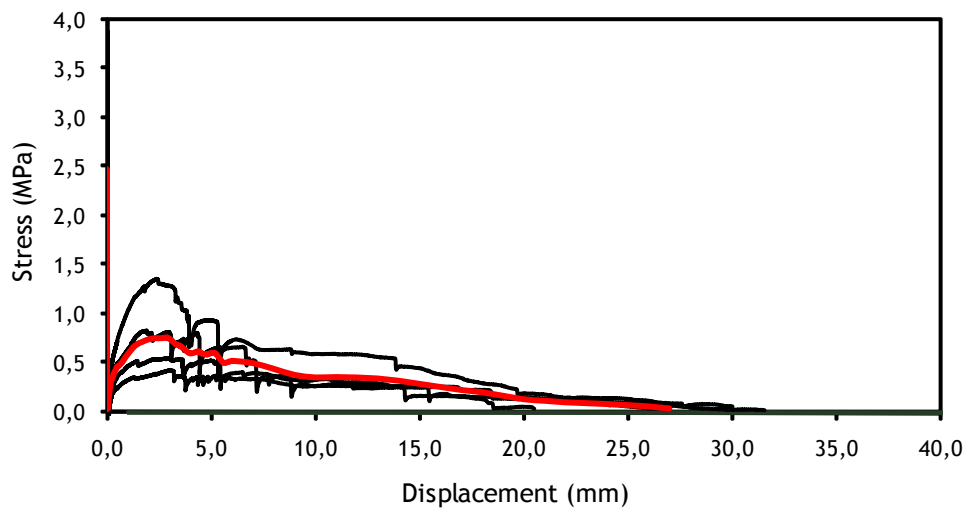
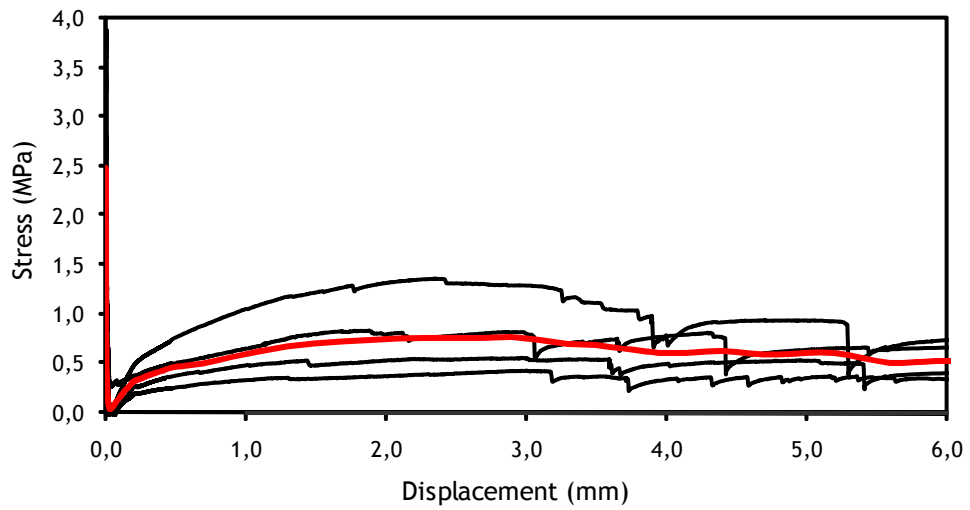
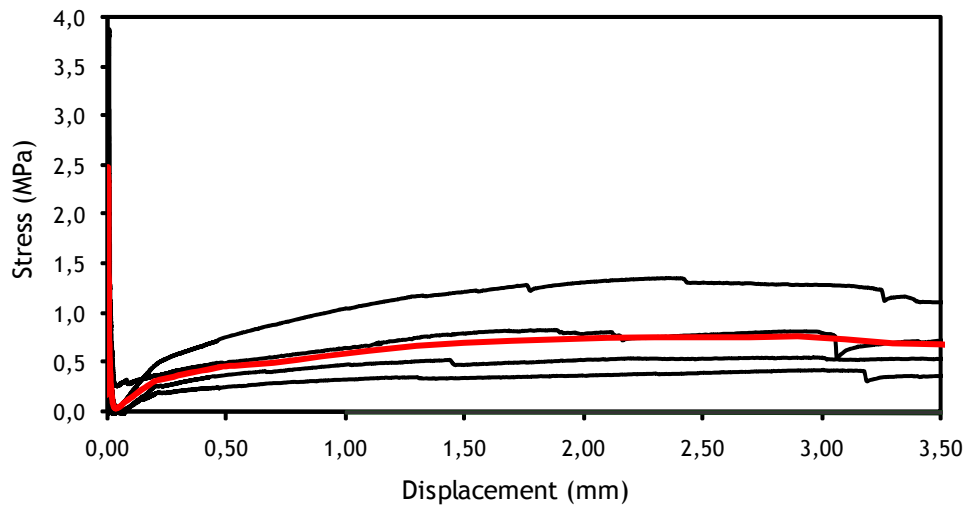
<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.063	0.022
0.300	0.328	0.057
0.500	0.477	0.185
2.000	0.754	1.181
3.500	0.584	2.679
6.000	0.533	3.821



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	2.737	0.000
Second peak (S ₂)	2.542	0.796	1.504
Last value (S ₃)	27.061	0.221	8.970

δ₁ = 0.0052 mm





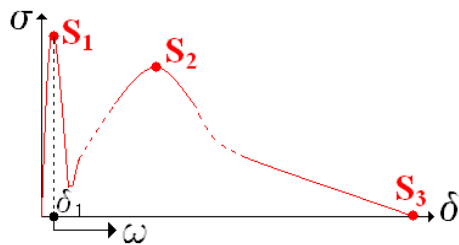
Single test

20 kg/m³ of steel fibers



<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	20
Specimen number	1
Notation	B20-1
<i>Number of fibers at the cracked section</i>	
36	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.038	0.017
0.300	0.597	0.117
0.500	0.770	0.249
2.000	1.319	1.919
3.500	1.110	3.846
6.000	0.736	6.069

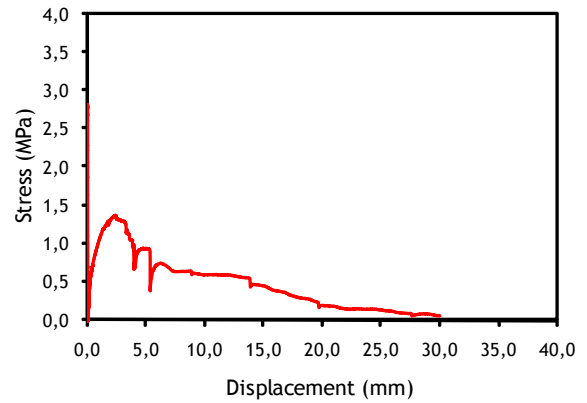
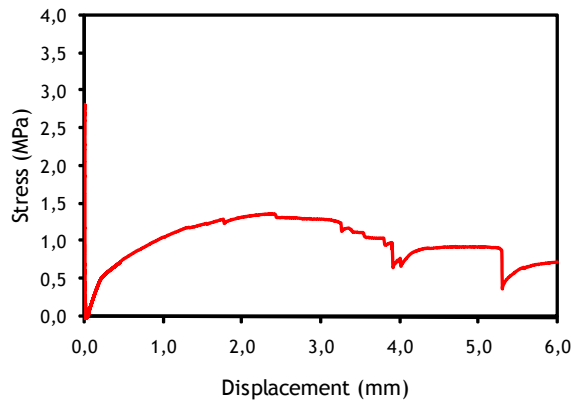
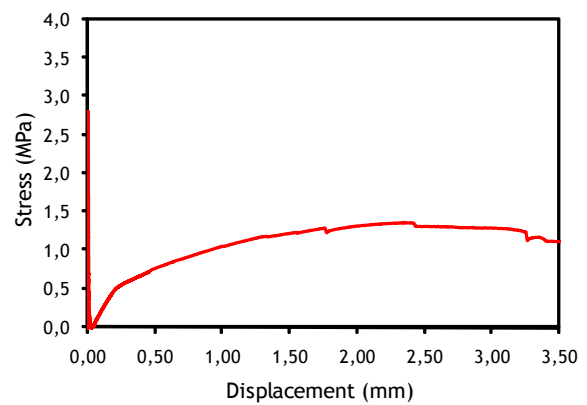
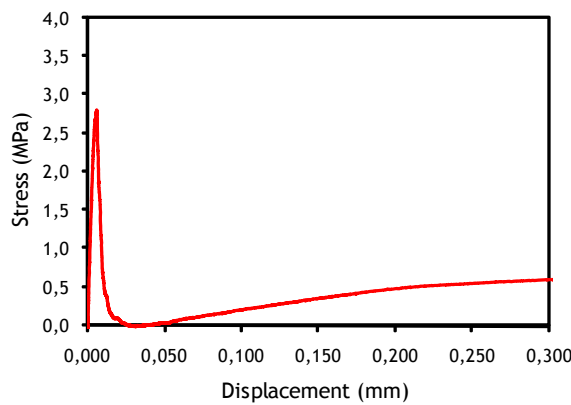


<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	2.814	0.000
Second peak (S ₂)	2.342	1.365	2.383
Last value (S ₃)	29.952	0.221	14.233

Comments:

$\delta_1 = 0.0057 \text{ mm}$

The test was unstable at the post-peak branch due to the sudden loss of specimen's stiffness that took place after cracking.



Single test

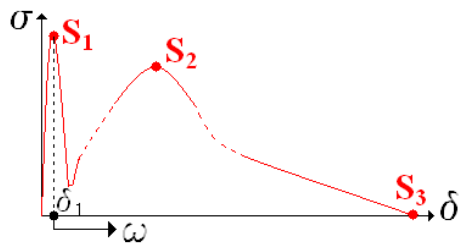
20 kg/m³ of steel fibers



<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	20
Specimen number	2
Notation	B20-2

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

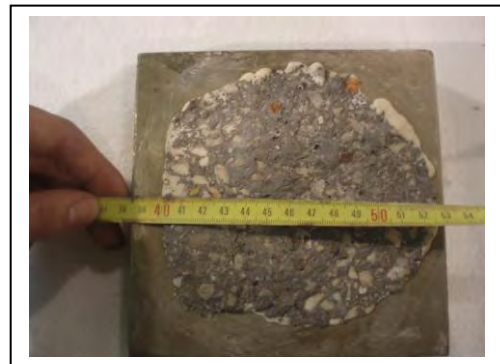
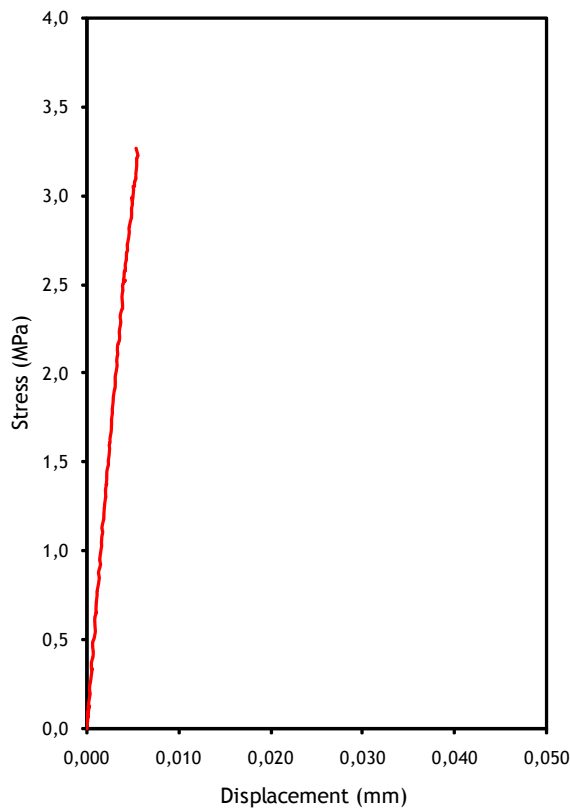
<i>Number of fibers at the cracked section</i>
--



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]

Comments:

Test failed. Cracking occurred between the steel plate and the specimen's bottom surface because spreading of the adhesive was rather poor, returning a contact surface smaller than the notched cross-section.



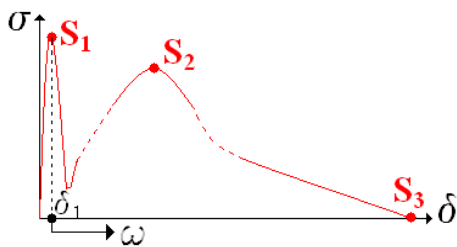
Single test

20 kg/m³ of steel fibers



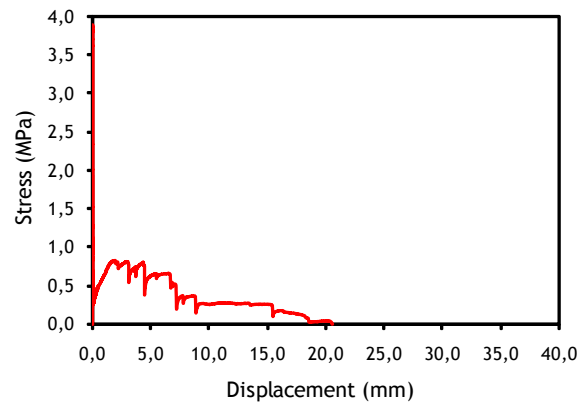
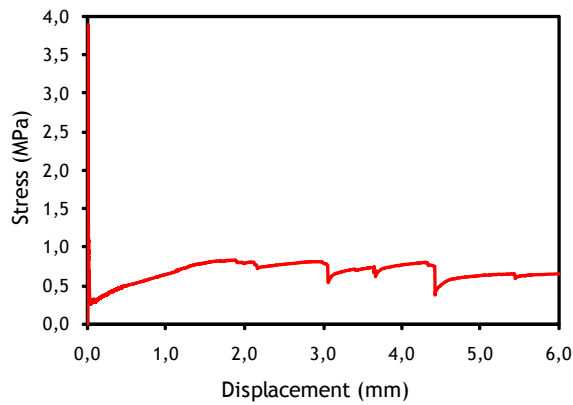
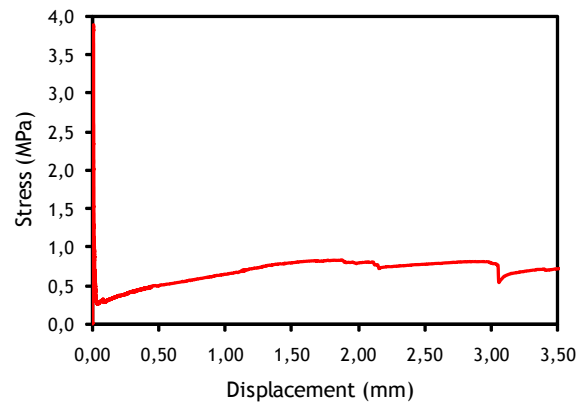
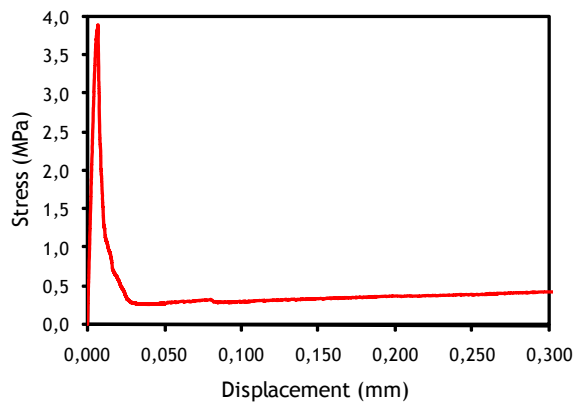
<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	20
Specimen number	3
Notation	B20-3
<i>Number of fibers at the cracked section</i>	
24	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.286	0.042
0.300	0.421	0.148
0.500	0.504	0.259
2.000	0.796	1.354
3.500	0.722	2.489
6.000	0.656	4.255



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	3.892	0.000
Second peak (S ₂)	1.869	0.832	1.257
Last value (S ₃)	20.496	0.221	7.837

δ₁ = 0.0067 mm



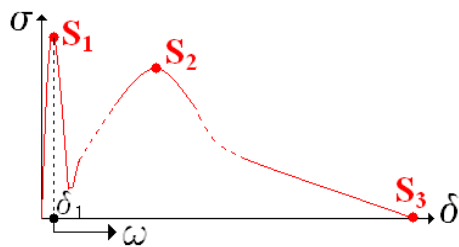
Single test

20 kg/m³ of steel fibers



<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	20
Specimen number	4
Notation	B20-4
<i>Number of fibers at the cracked section</i>	
23	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.000	0.020
0.300	0.218	0.058
0.500	0.260	0.106
2.000	0.373	0.610
3.500	0.369	1.202
6.000	0.341	2.092

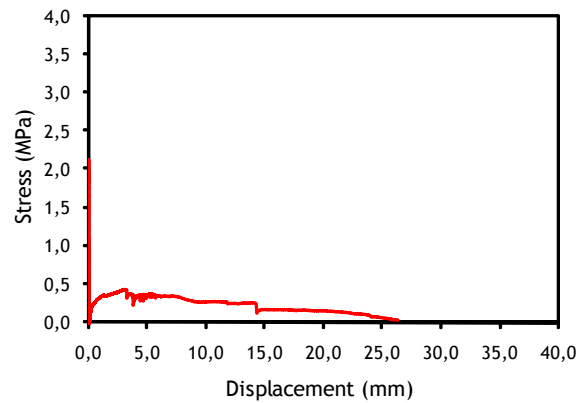
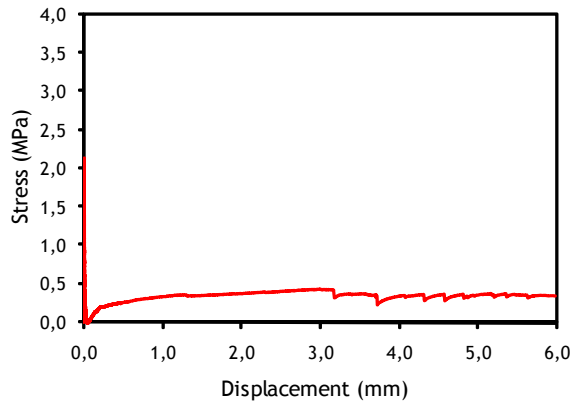
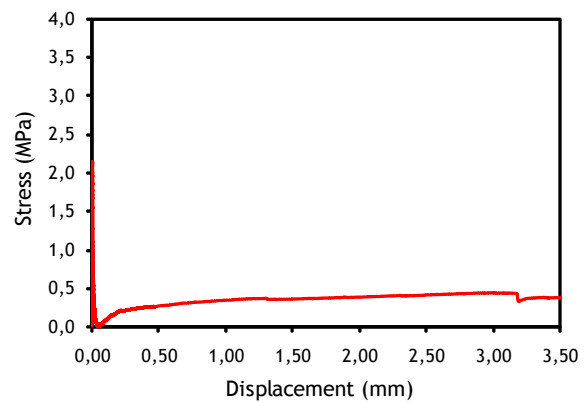
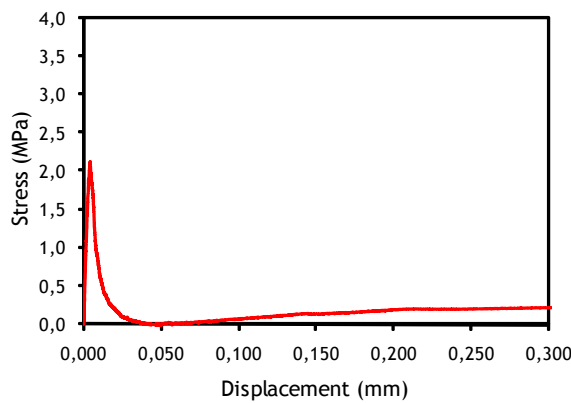


<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	2.131	0.000
Second peak (S ₂)	2.997	0.432	1.012
Last value (S ₃)	26.314	0.221	5.973

Comments:

$\delta_1 = 0.0041$ mm

The test was unstable at the post-peak branch due to the sudden loss of specimen's stiffness that took place after cracking.



Single test

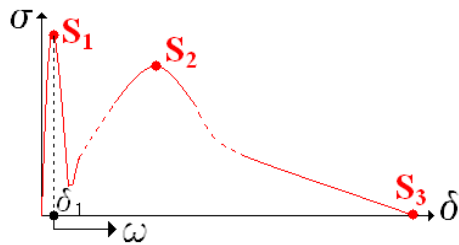
20 kg/m³ of steel fibers



<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	20
Specimen number	5
Notation	B20-5

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

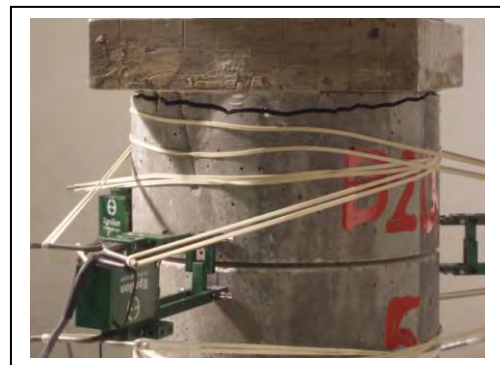
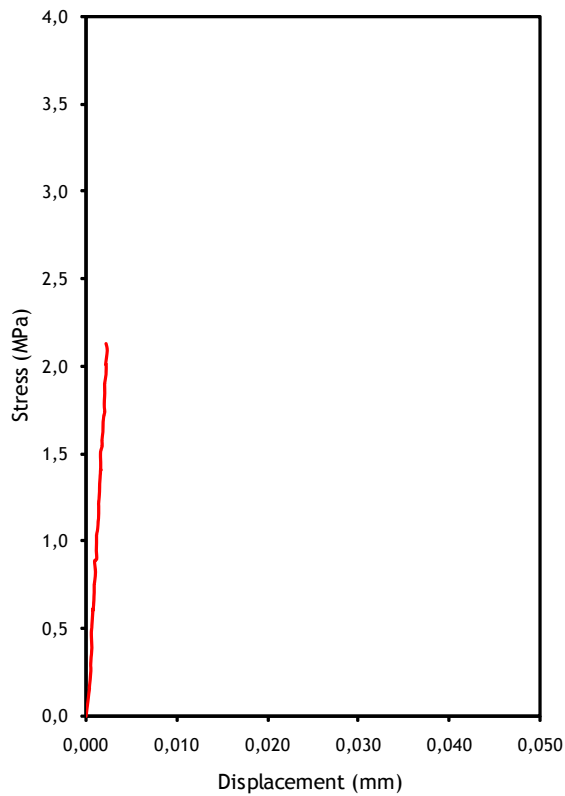
<i>Number of fibers at the cracked section</i>
--



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]

Comments:

Test failed
Cracking occurred outside of the notch.



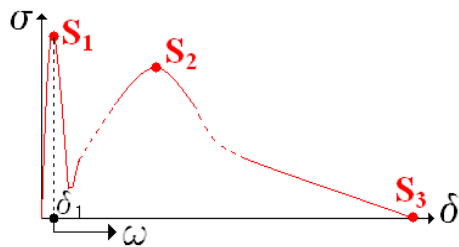
Single test

20 kg/m³ of steel fibers



<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	20
Specimen number	6
Notation	B20-6
<i>Number of fibers at the cracked section</i>	
22	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	-0.070	0.010
0.300	0.299	0.057
0.500	0.377	0.125
2.000	0.528	0.839
3.500	0.536	1.649
6.000	0.399	2.870

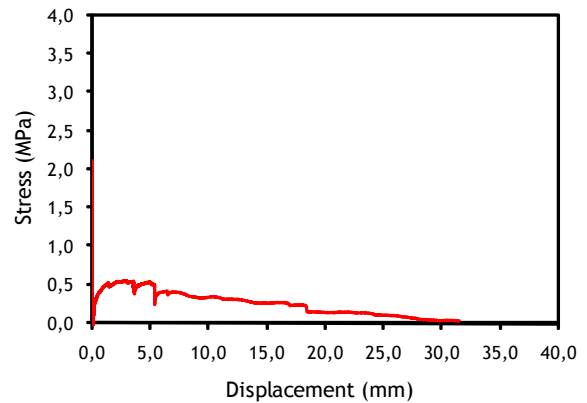
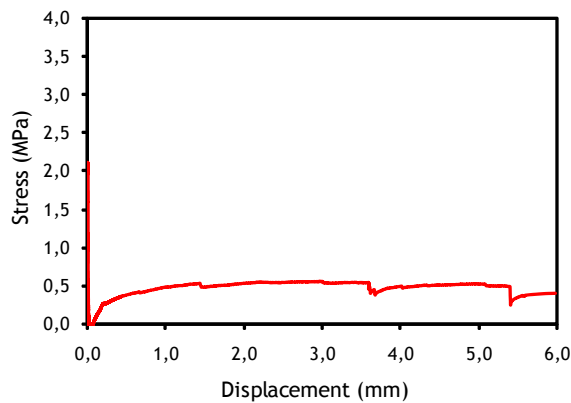
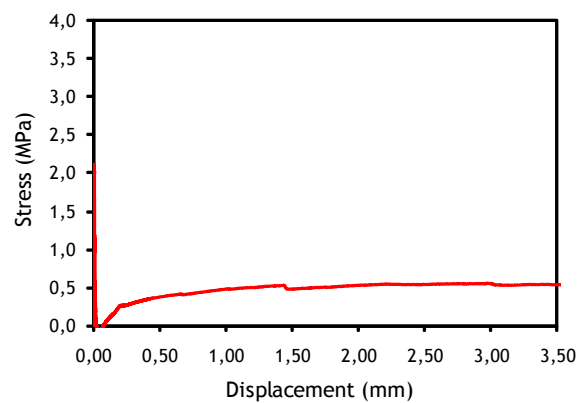
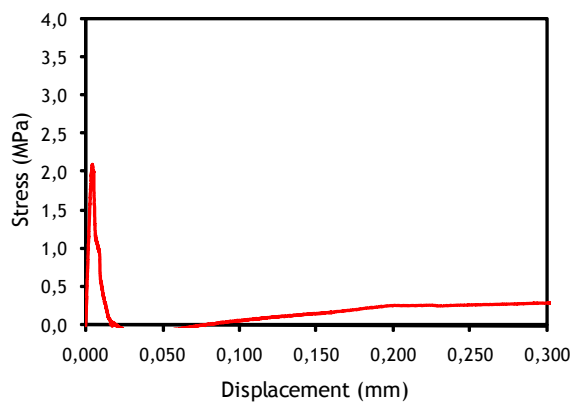


<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	2.113	0.000
Second peak (S ₂)	2.961	0.556	1.363
Last value (S ₃)	31.483	0.221	7.835

$\delta_1 = 0.0044 \text{ mm}$

Comments:

The test was unstable at the post-peak branch due to the sudden loss of specimen's stiffness that took place after cracking.



A1.8 SERIE B40

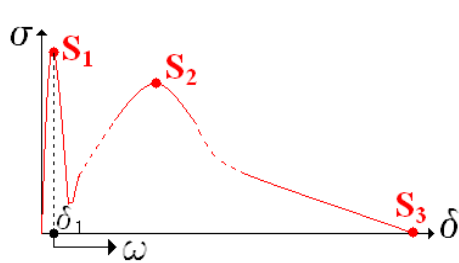
Average results

40 kg/m³ of steel fibers



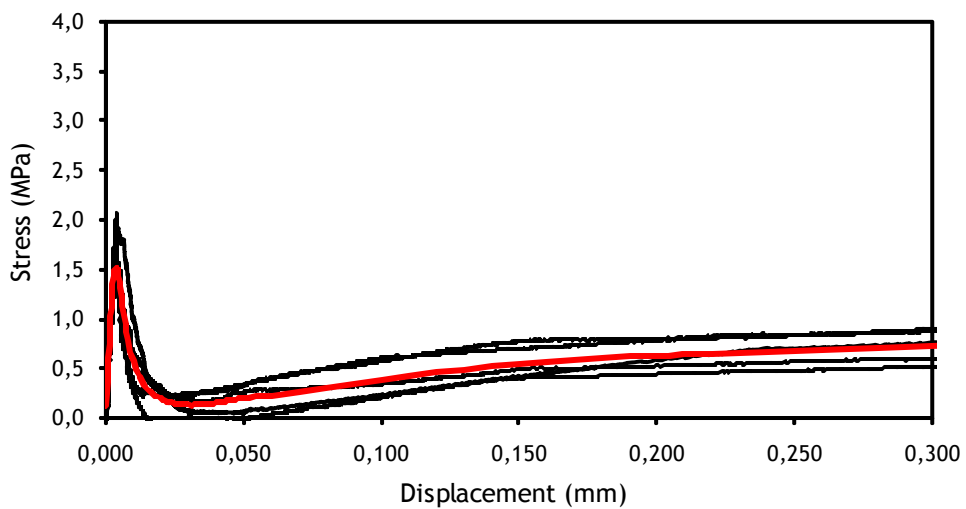
Characteristics	
Concrete type	B
Fibers (kg/m ³)	40
Number of valid tests	5
Notation	B40
Number of fibers at the cracked section	
	55

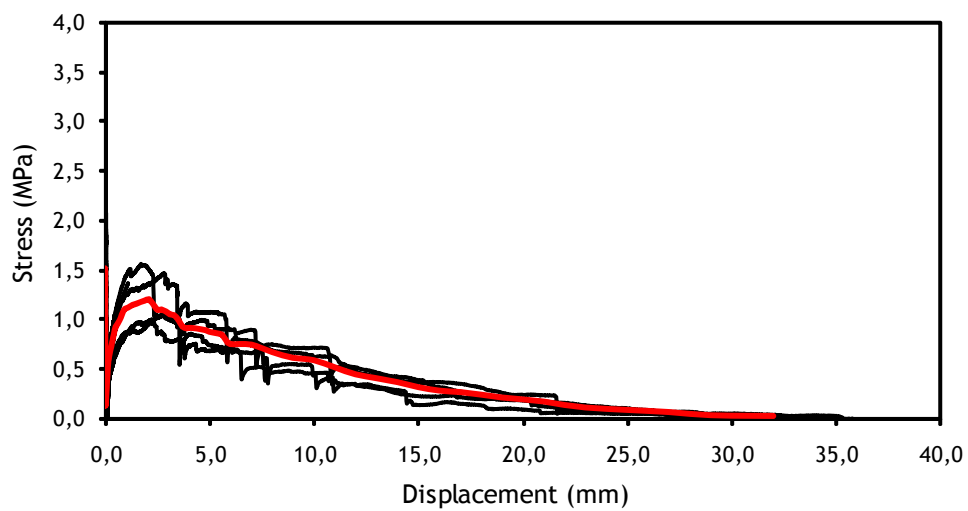
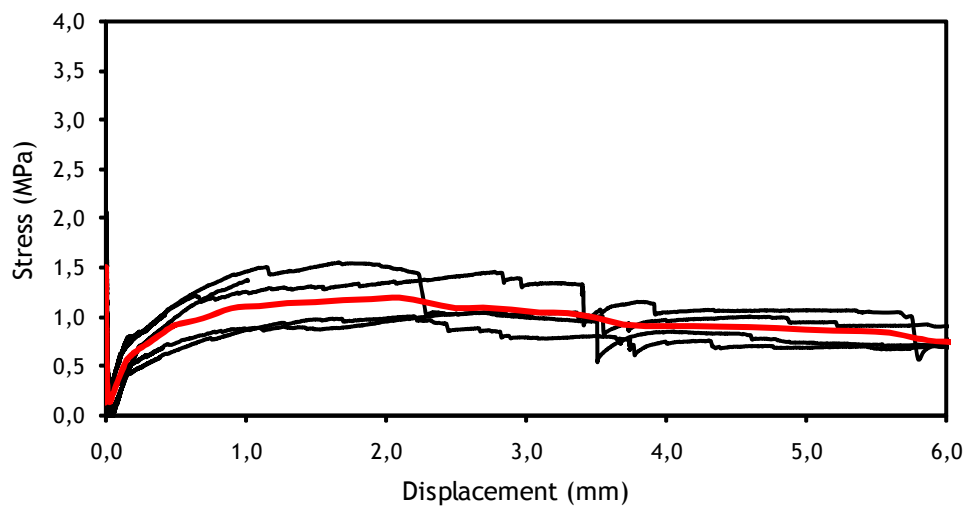
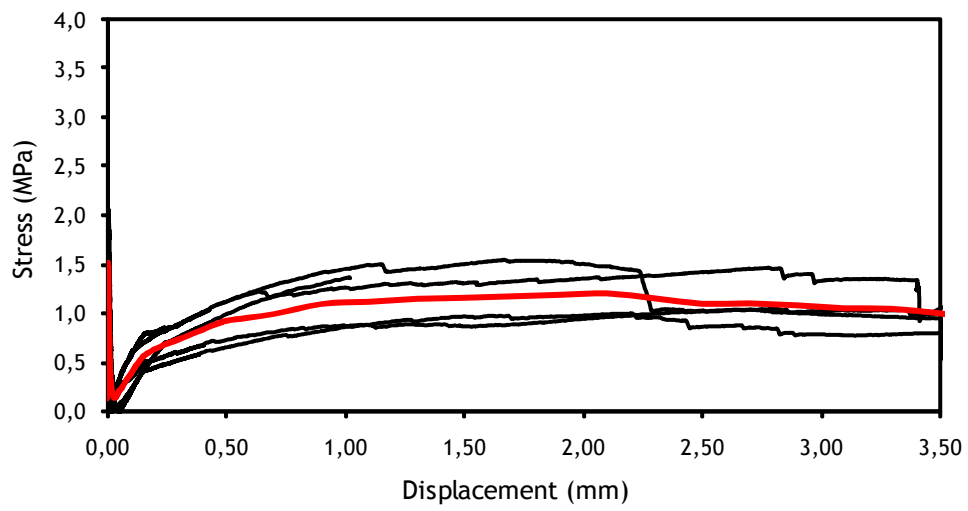
Reference values		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.215	0.022
0.300	0.740	0.150
0.500	0.932	0.333
2.000	1.200	2.017
3.500	0.908	3.717
6.000	0.765	6.000



Significant values			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	1.669	0.000
Second peak (S ₂)	2.346	1.272	2.402
Last value (S ₃)	30.111	0.221	12.642

$\delta_1 = 0.0041 \text{ mm}$





Single test

40 kg/m³ of steel fibers



Characteristics

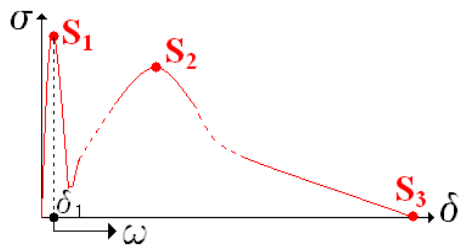
Concrete type	B
Fibers (kg/m ³)	40
Specimen number	1
Notation	B40-1

Number of fibers at the cracked section

58

Reference values

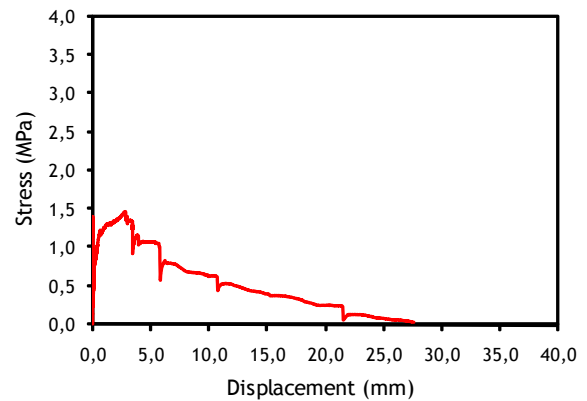
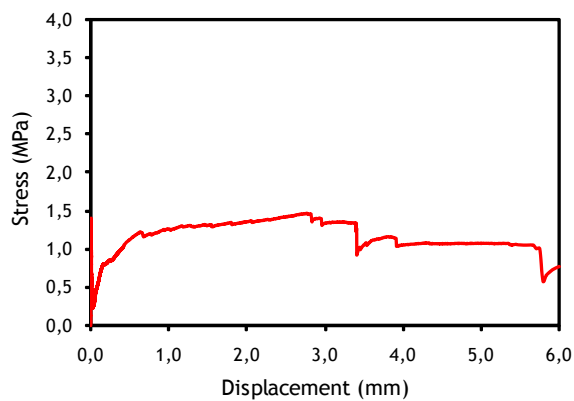
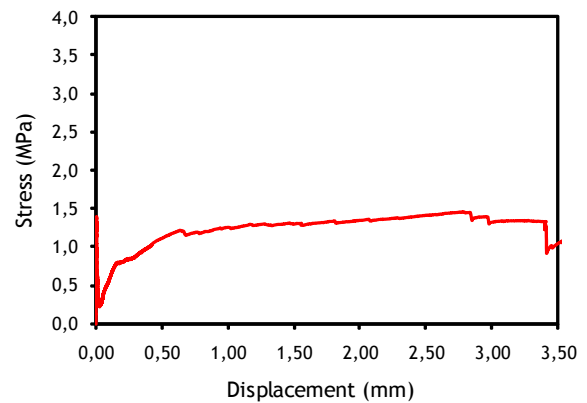
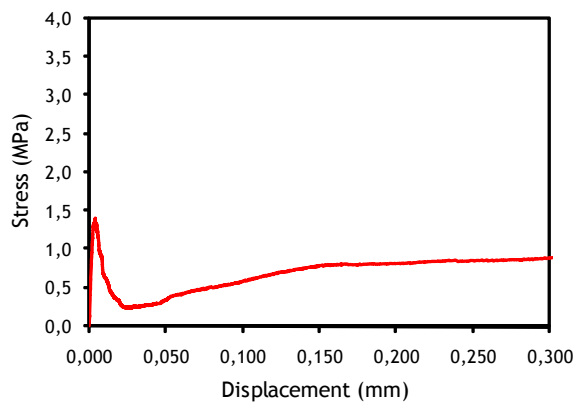
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.355	0.030
0.300	0.891	0.223
0.500	1.123	0.423
2.000	1.354	2.340
3.500	1.041	4.687
6.000	0.770	7.262



Significant values

Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	1.400	0.000
Second peak (S ₂)	2.767	1.466	3.422
Last value (S ₃)	27.667	0.221	15.055

δ₁ = 0.0040 mm



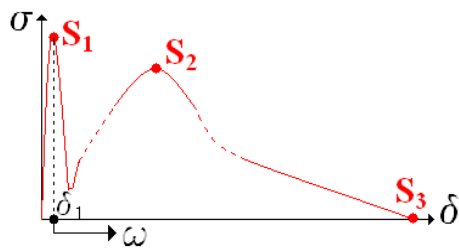
Single test

40 kg/m³ of steel fibers



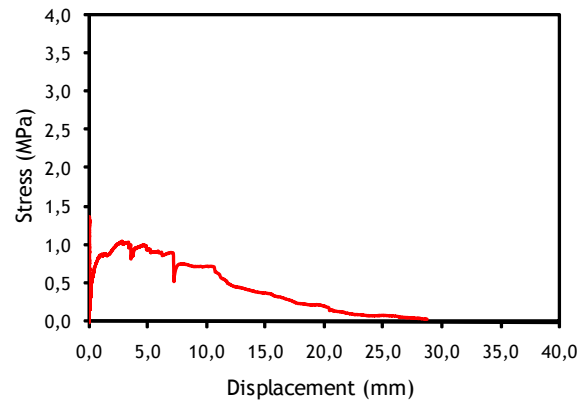
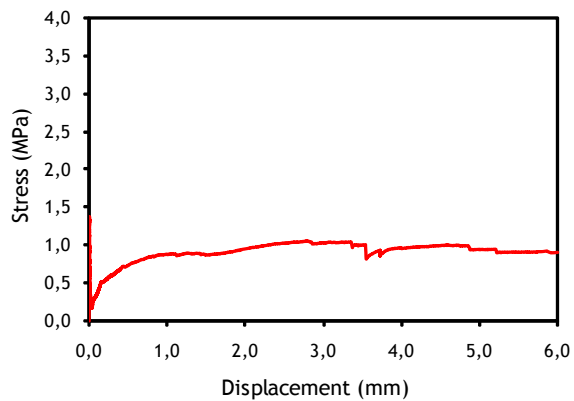
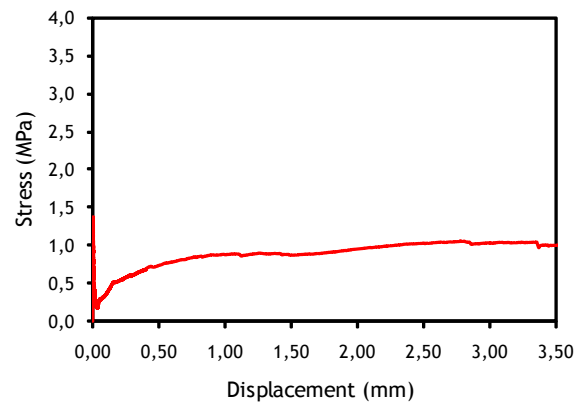
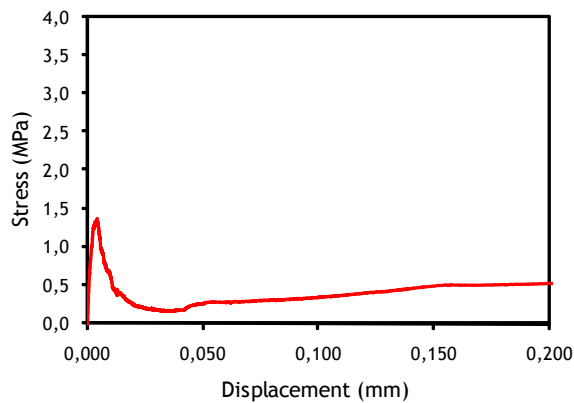
Characteristics	
Concrete type	B
Fibers (kg/m ³)	40
Specimen number	2
Notation	B40-2
Number of fibers at the cracked section	
47	

Reference values		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.278	0.025
0.300	0.607	0.148
0.500	0.735	0.281
2.000	0.949	1.582
3.500	0.984	3.105
6.000	0.899	5.708



Significant values			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	1.371	0.000
Second peak (S ₂)	2.775	1.055	2.372
Last value (S ₃)	28.705	0.221	13.267

δ₁ = 0.0042 mm



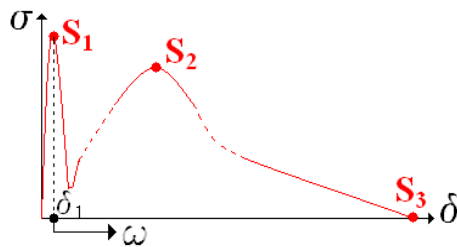
Single test

40 kg/m³ of steel fibers



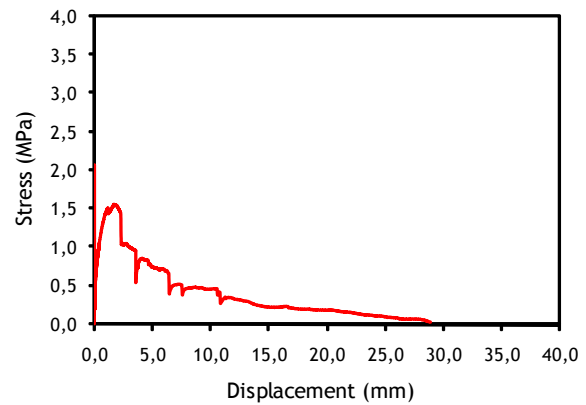
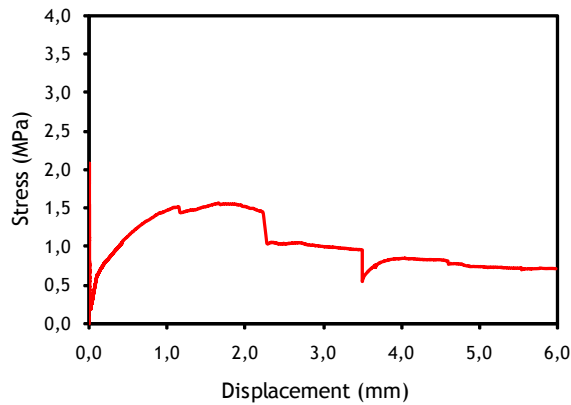
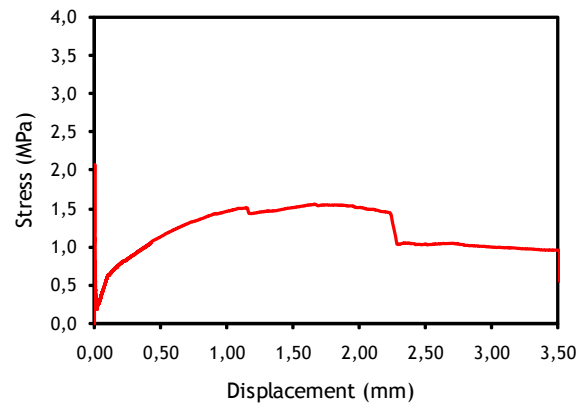
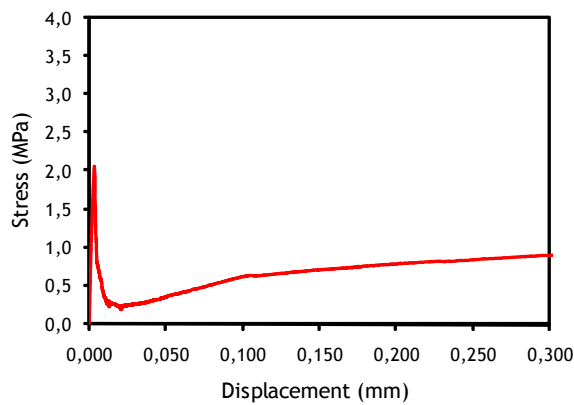
<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	40
Specimen number	3
Notation	B40-3
<i>Number of fibers at the cracked section</i>	
67	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.361	0.028
0.300	0.903	0.128
0.500	1.135	0.213
2.000	1.510	2.583
3.500	0.802	4.216
6.000	0.703	6.238



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	2.071	0.000
Second peak (S ₂)	1.653	1.559	2.056
Last value (S ₃)	28.941	0.221	11.915

$\delta_1 = 0.0034 \text{ mm}$



Single test

40 kg/m³ of steel fibers



Characteristics

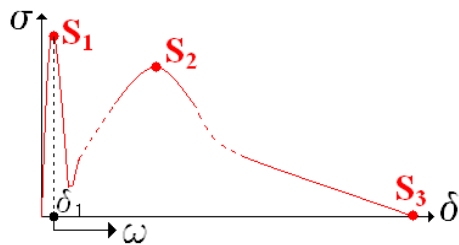
Concrete type	B
Fibers (kg/m ³)	40
Specimen number	4
Notation	B40-4

Reference values

Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.062	0.025
0.300	0.764	0.150
0.500	1.000	0.325

Number of fibers at the cracked section

--



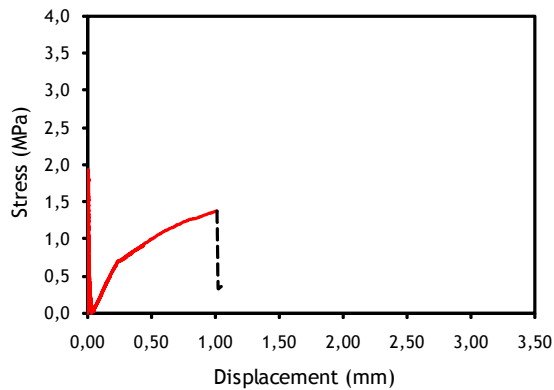
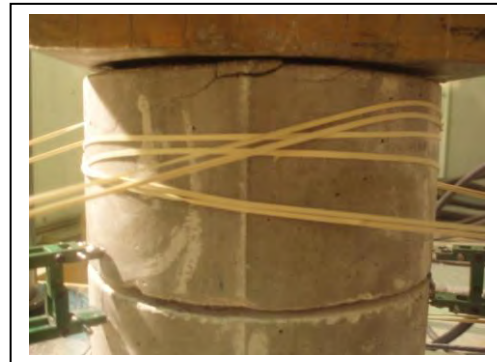
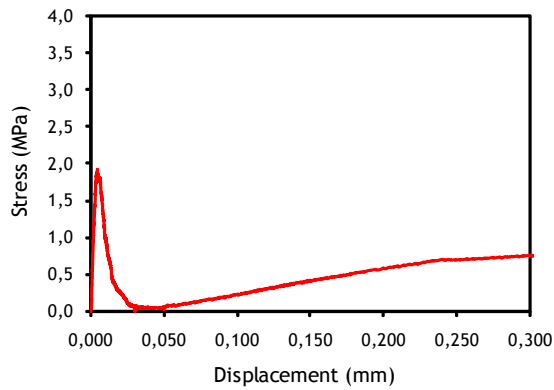
Significant values

Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	1.925	0.000

δ₁ = 0.0045 mm

Comments:

A crack appeared at the top of the specimen at a crack width of 1.0mm.



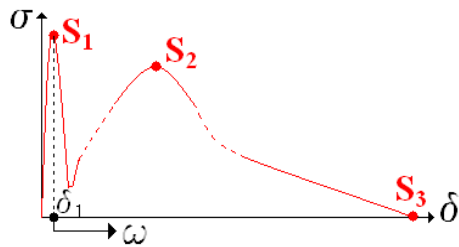
Single test

40 kg/m³ of steel fibers



<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	40
Specimen number	5
Notation	B40-5
<i>Number of fibers at the cracked section</i>	
	49

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.018	0.003
0.300	0.536	0.102
0.500	0.667	0.220
2.000	0.988	1.561
3.500	0.806	2.861
6.000	0.689	4.792

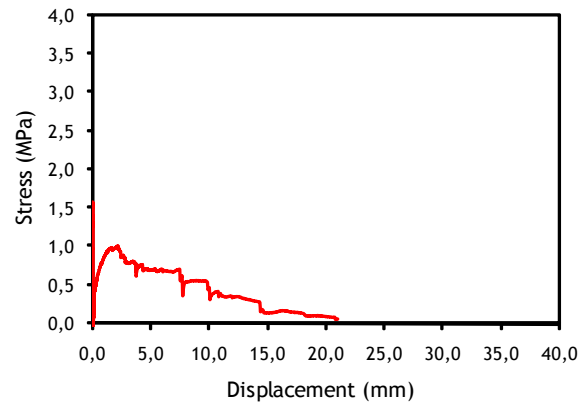
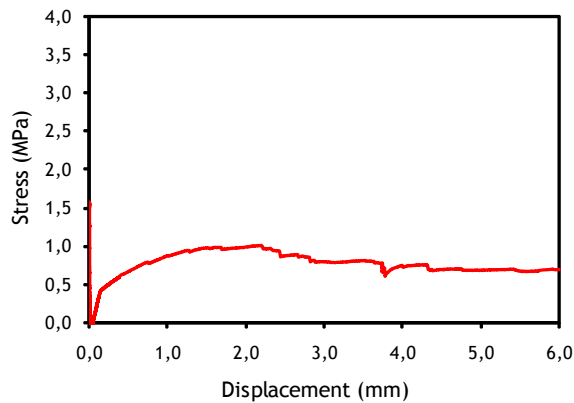
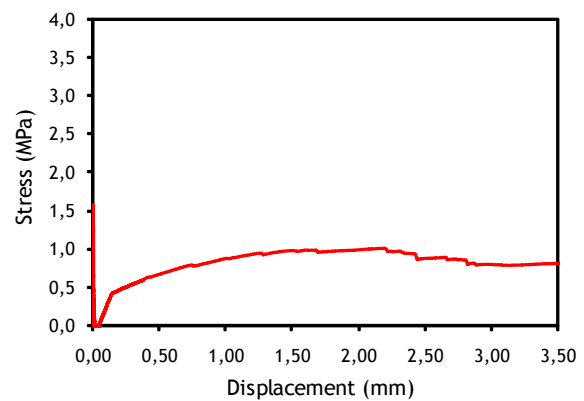
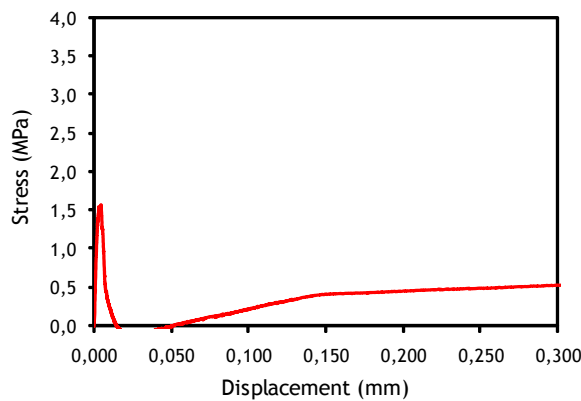


<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	1.579	0.000
Second peak (S ₂)	2.191	1.010	1.757
Last value (S ₃)	35.131	0.221	10.332

$\delta_1 = 0.0045 \text{ mm}$

Comments:

The test was unstable at the post-peak branch due to the sudden loss of specimen's stiffness that took place after cracking.



Single test

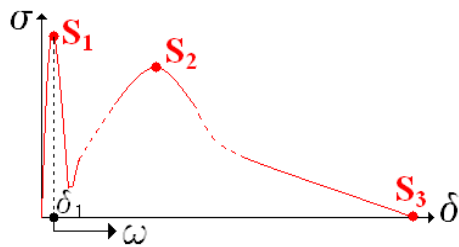
40 kg/m³ of steel fibers



<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	40
Specimen number	6
Notation	B40-6

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]

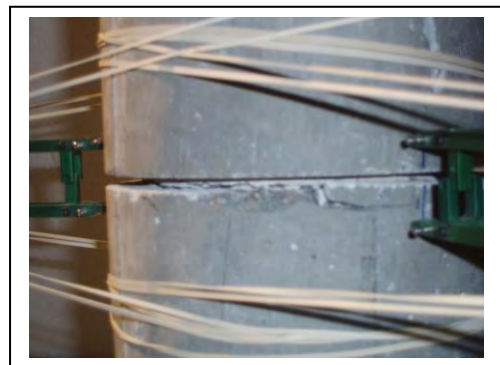
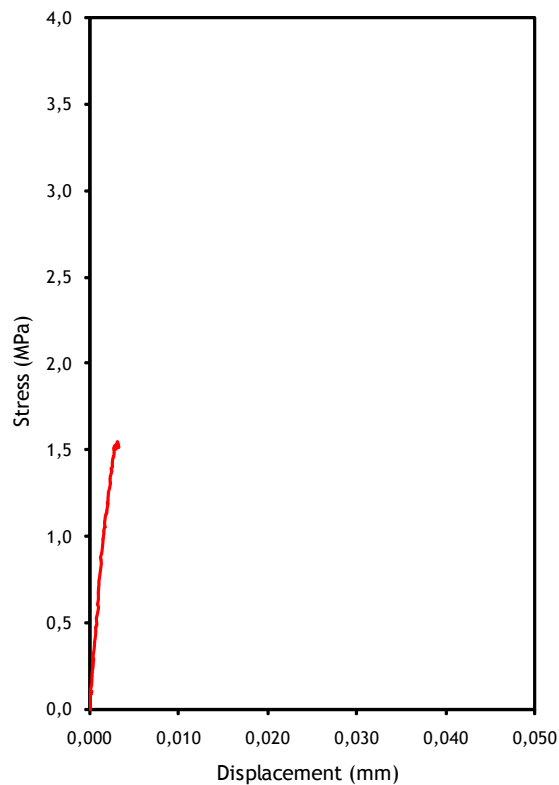
<i>Number of fibers at the cracked section</i>
--



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]

Comments:

Test failed due to crack formation outside of the notch. This caused sudden deformations on the extensometers at the initial stage of the test which led to resonance loads and strong instability of the testing equipment.



A1.9 SERIE B60

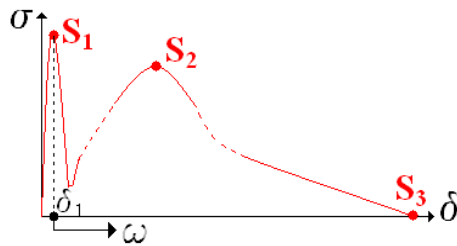
Average results

60 kg/m³ of steel fibers



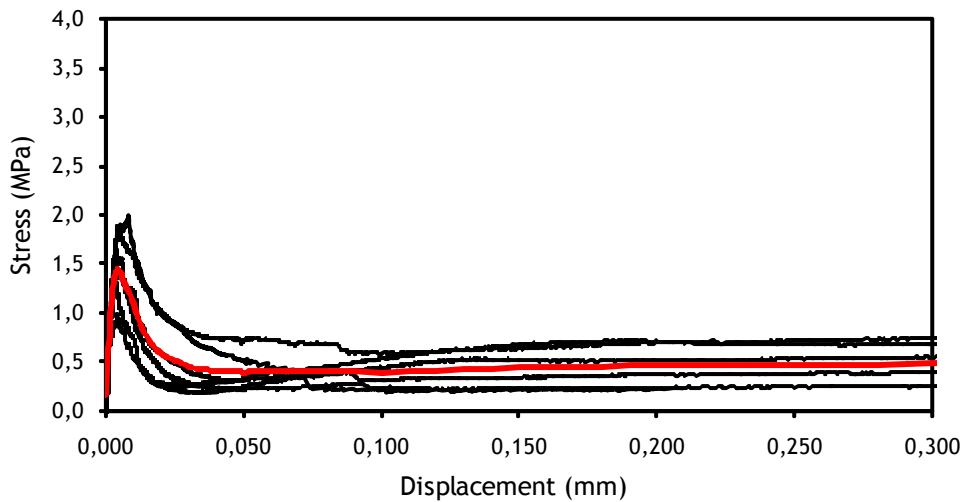
<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	60
Number of valid tests	6
Notation	B60
<i>Number of fibers at the cracked section</i>	
53	

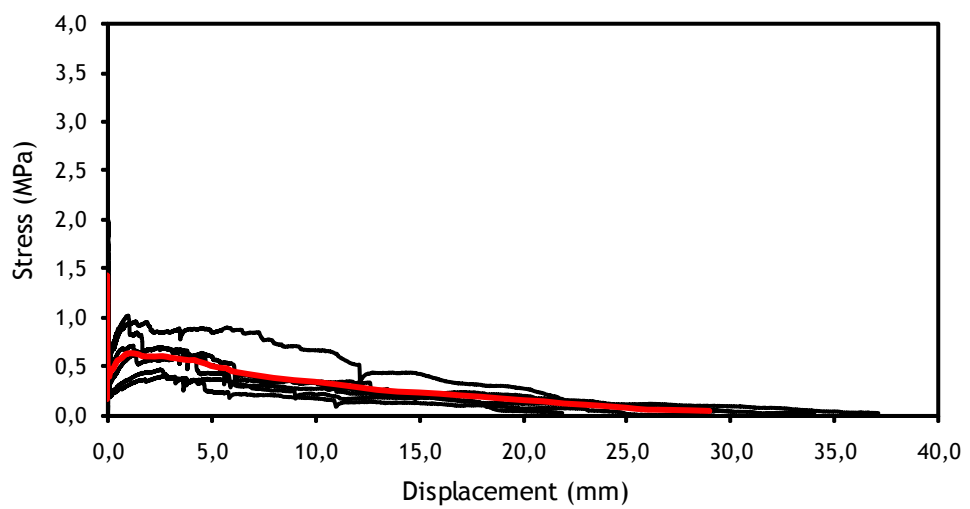
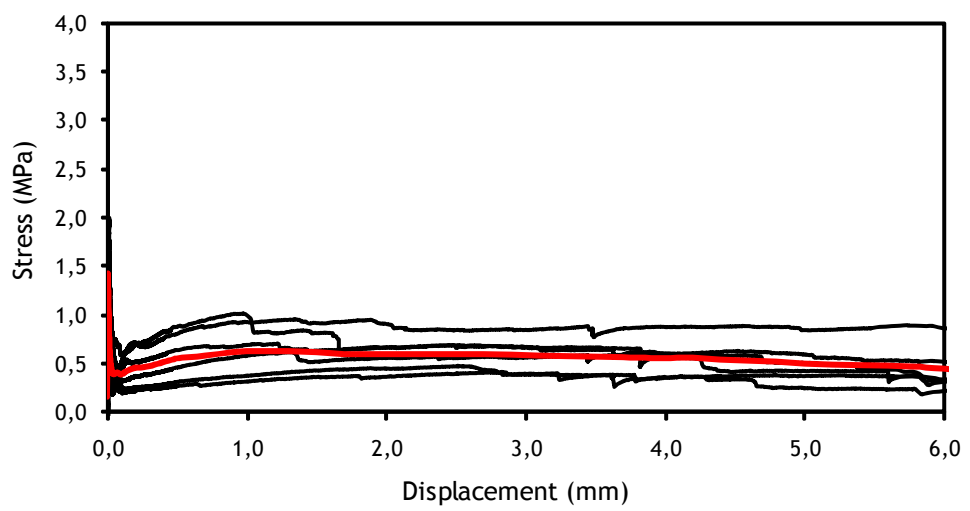
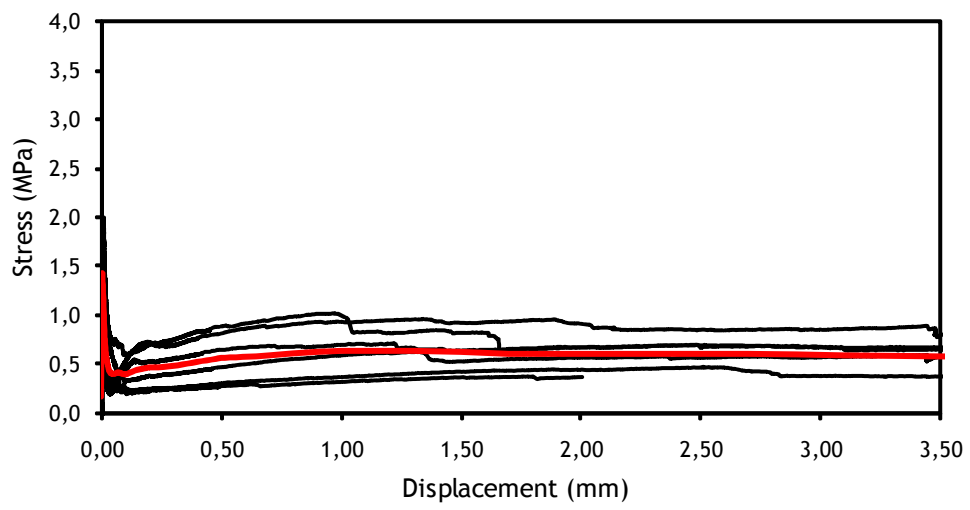
<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.394	0.053
0.300	0.485	0.172
0.500	0.567	0.280
2.000	0.604	1.209
3.500	0.578	2.311
6.000	0.435	3.496



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	1.559	0.000
Second peak (S ₂)	1.688	0.703	0.916
Last value (S ₃)	28.906	0.221	8.125

$\delta_1 = 0.0043 \text{ mm}$





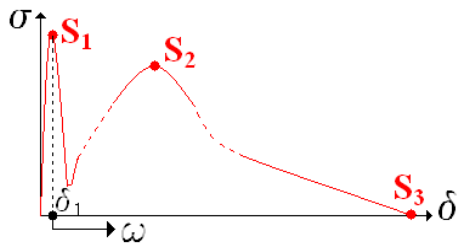
Single test

60 kg/m³ of steel fibers



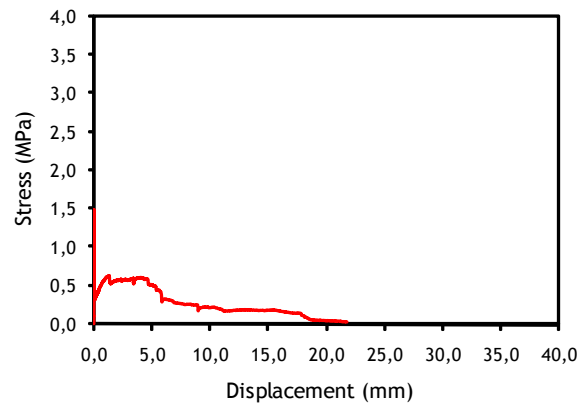
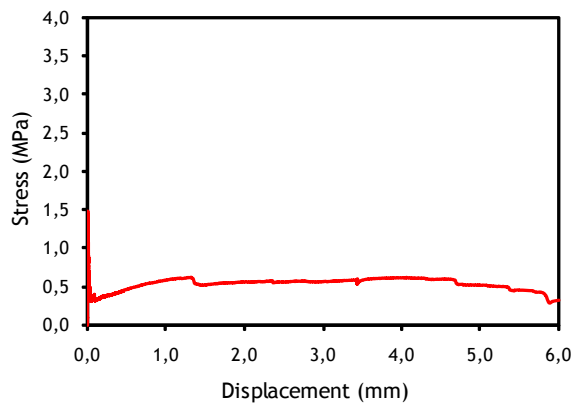
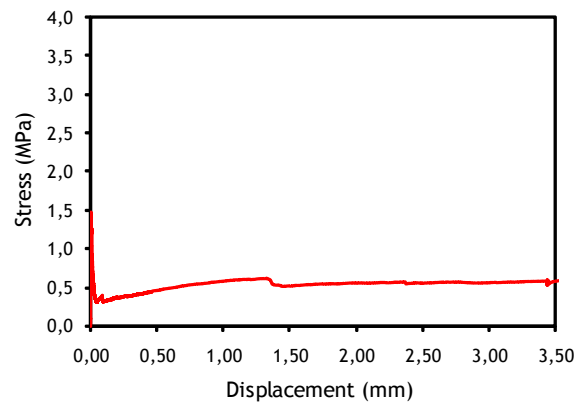
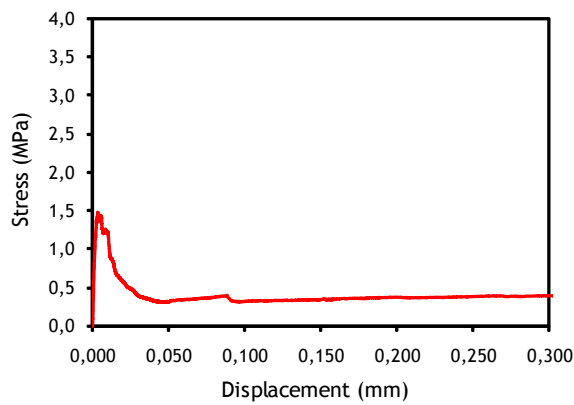
<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	60
Specimen number	1
Notation	B60-1
<i>Number of fibers at the cracked section</i>	
42	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.324	0.046
0.300	0.398	0.142
0.500	0.467	0.226
2.000	0.565	1.062
3.500	0.572	2.036
6.000	0.320	3.340



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	1.487	0.000
Second peak (S ₂)	1.314	0.627	0.688
Last value (S ₃)	21.834	0.221	5.951

$\delta_1 = 0.0034 \text{ mm}$



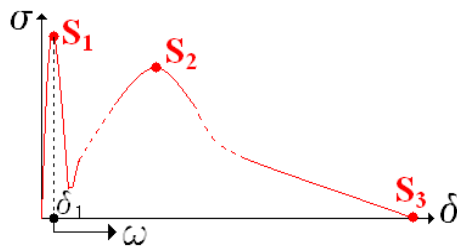
Single test

60 kg/m³ of steel fibers



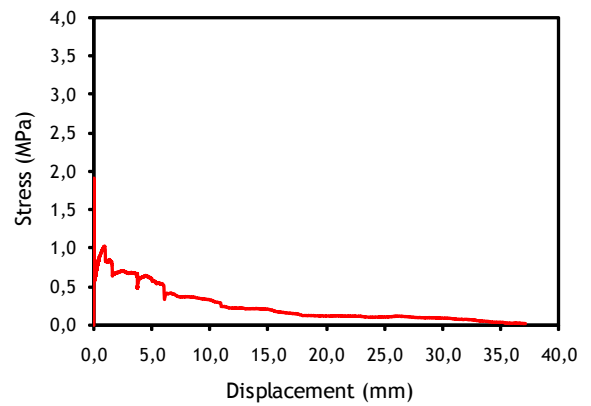
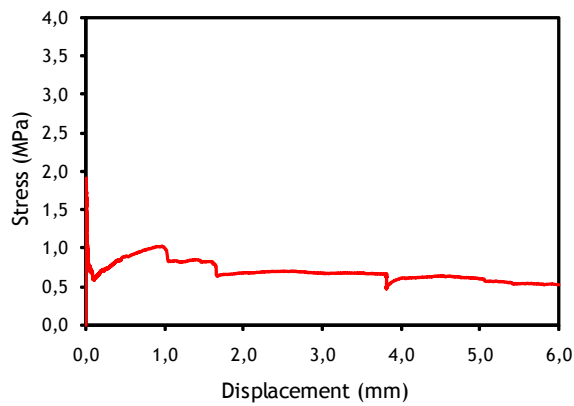
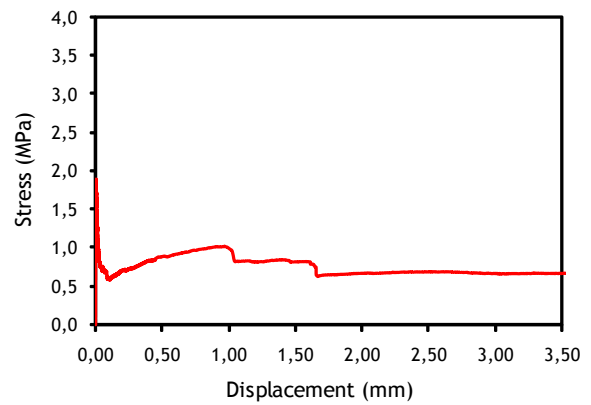
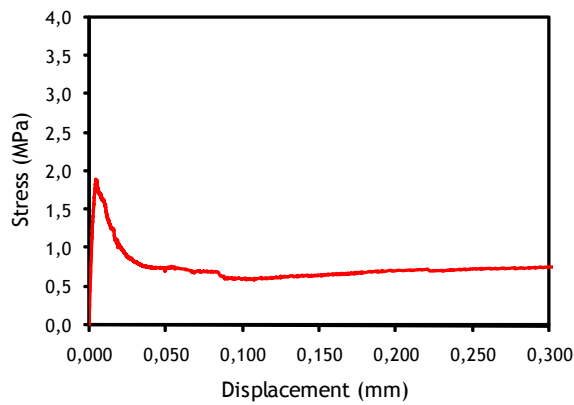
<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	60
Specimen number	2
Notation	B60-2
<i>Number of fibers at the cracked section</i>	
65	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.736	0.078
0.300	0.758	0.263
0.500	0.889	0.430
2.000	0.675	1.689
3.500	0.673	2.706
6.000	0.525	4.250



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	1.903	0.000
Second peak (S ₂)	0.957	1.025	0.873
Last value (S ₃)	37.125	0.221	9.169

δ₁ = 0.0041 mm



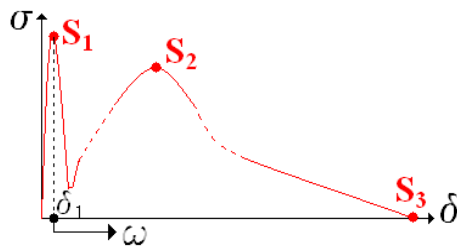
Single test

60 kg/m³ of steel fibers



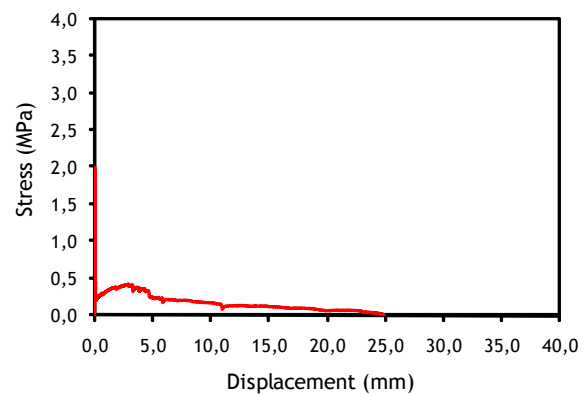
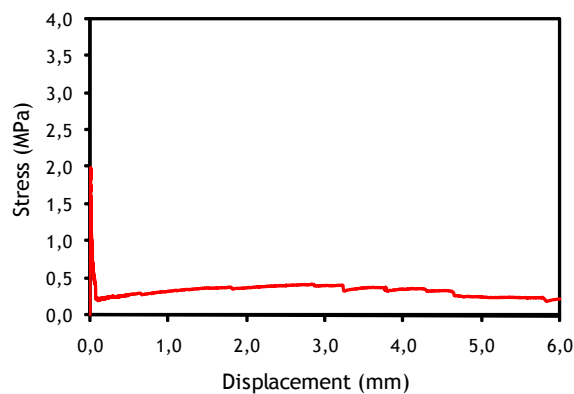
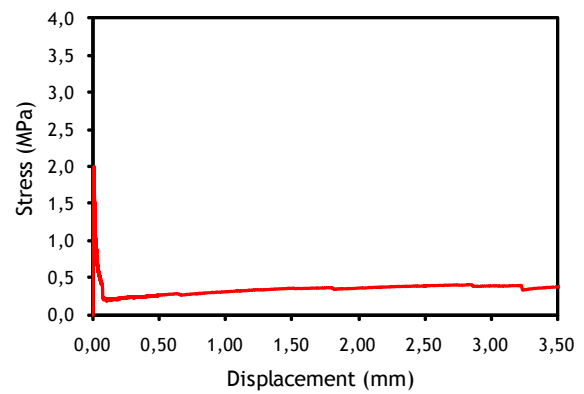
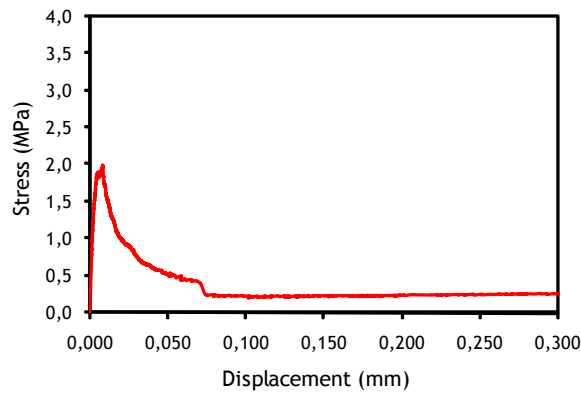
<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	60
Specimen number	3
Notation	B60-3
<i>Number of fibers at the cracked section</i>	
40	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.452	0.090
0.300	0.238	0.158
0.500	0.275	0.216
2.000	0.365	0.714
3.500	0.378	1.303
6.000	0.218	2.101



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	1.994	0.000
Second peak (S ₂)	2.816	0.414	1.048
Last value (S ₃)	24.953	0.221	4.486

δ₁ = 0.0081 mm



Single test

60 kg/m³ of steel fibers



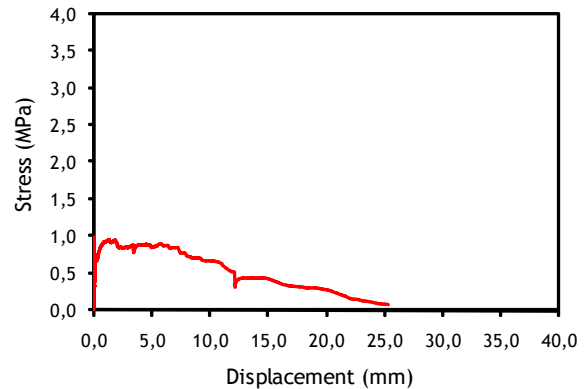
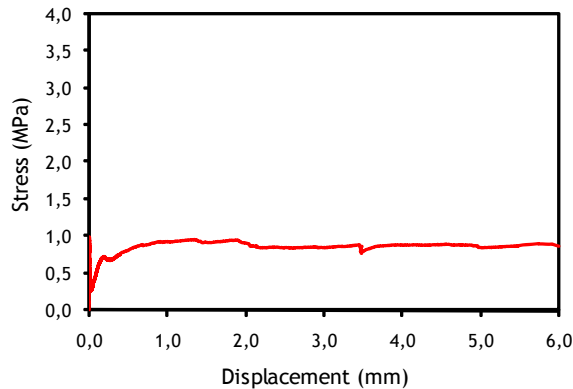
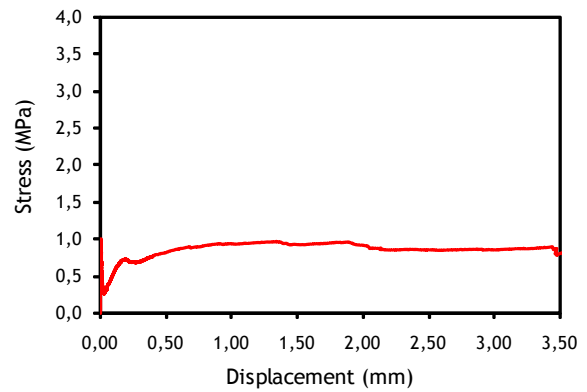
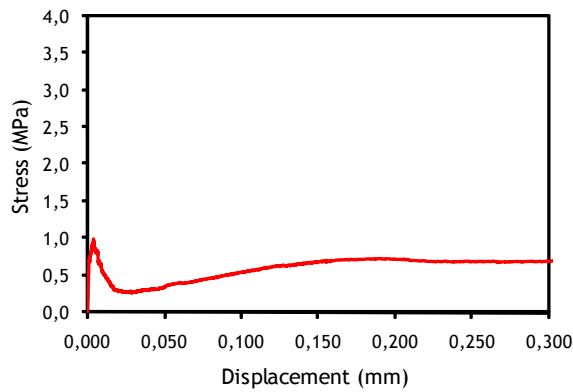
<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	60
Specimen number	4
Notation	B60-4
<i>Number of fibers at the cracked section</i>	
79	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.347	0.027
0.300	0.690	0.190
0.500	0.810	0.353
2.000	0.900	1.726
3.500	0.815	3.128
6.000	0.865	5.301



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	0.989	0.000
Second peak (S ₂)	1.332	0.956	1.111
Last value (S ₃)	25.285	0.221	13.270

δ₁ = 0.0039 mm



Single test

60 kg/m³ of steel fibers



Characteristics

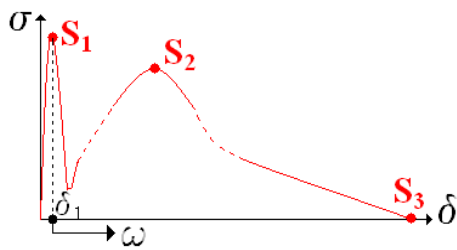
Concrete type	B
Fibers (kg/m ³)	60
Specimen number	5
Notation	B60-5

Number of fibers at the cracked section

58

Reference values

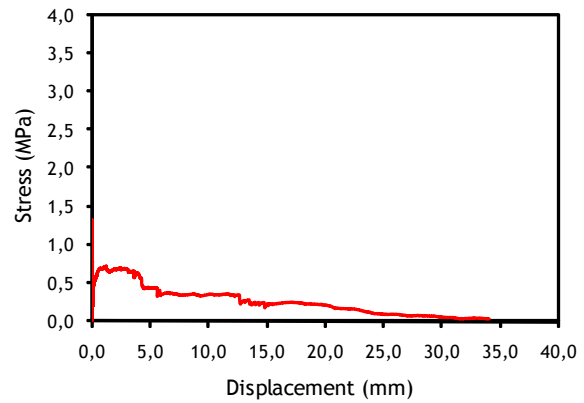
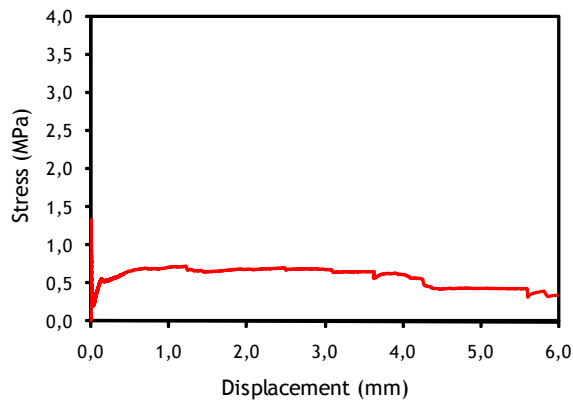
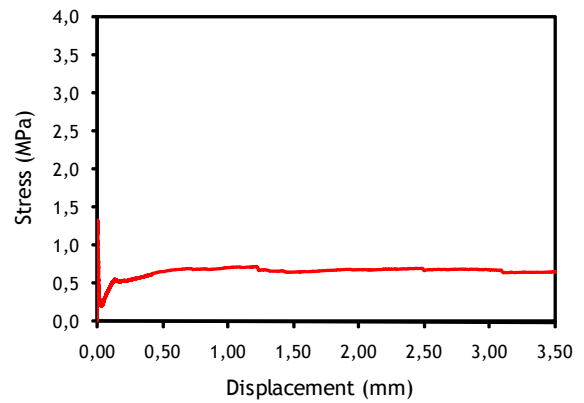
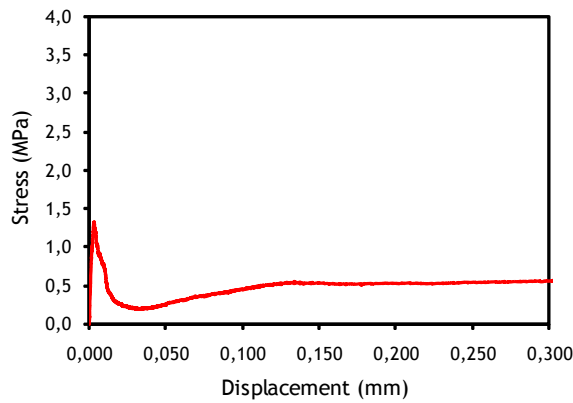
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.264	0.027
0.300	0.562	0.168
0.500	0.648	0.288
2.000	0.674	1.300
3.500	0.651	2.314
6.000	0.347	3.609



Significant values

Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	1.325	0.000
Second peak (S ₂)	1.206	0.718	0.779
Last value (S ₃)	34.057	0.221	8.814

δ₁ = 0.0032 mm



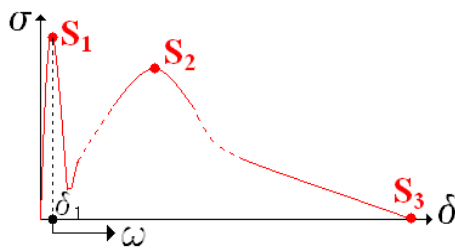
Single test

60 kg/m³ of steel fibers



<i>Characteristics</i>	
Concrete type	B
Fibers (kg/m ³)	60
Specimen number	6
Notation	B60-6
<i>Number of fibers at the cracked section</i>	
30	

<i>Reference values</i>		
Crack opening	Stress	Fracture Energy
[mm]	[MPa]	[N/mm]
0.050	0.238	0.047
0.300	0.261	0.113
0.500	0.311	0.170
2.000	0.447	0.763
3.500	0.378	1.396
6.000	0.333	2.377



<i>Significant values</i>			
Point	Crack opening	Stress	Fracture Energy
	[mm]	[MPa]	[N/mm]
First peak (S ₁)	0.000	1.658	0.000
Second peak (S ₂)	2.504	0.478	0.997
Last value (S ₃)	30.180	0.221	7.059

δ₁ = 0.0033 mm

