Theory of Structures - I

Chapter 5. Influence Lines for Simple Structures [Part II of III]

Lecturer: Dr. Sanjeema Bajracharya

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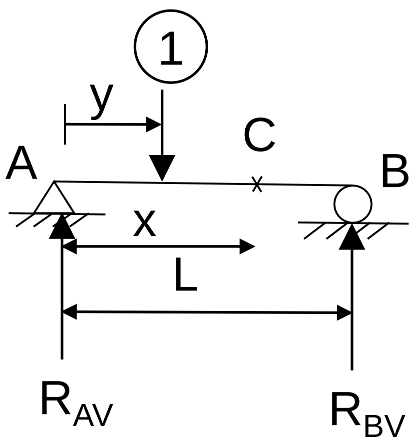
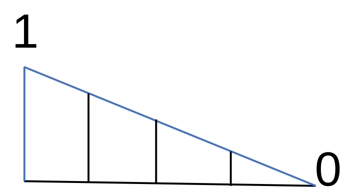
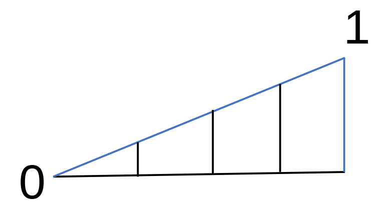
5.5 Influence Lines for Support Reactions

We have seen in the lecture 7, the Influence lines for support reactions R_{AV} and R_{BV} for a simply supported beam as unit point load moves across its span, as follows:





ILD for R_{AV}



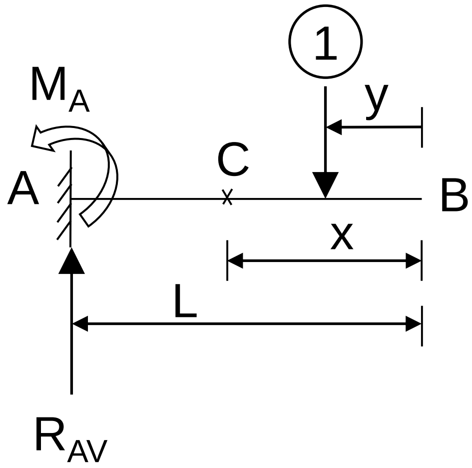
ILD for R_{BV}

Now, we will look at how influence lines vary for different support conditions – e.g. a cantilever beam, overhanging beam, etc.

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.5 Influence Lines for Support Reactions

[A] Cantilever beam:

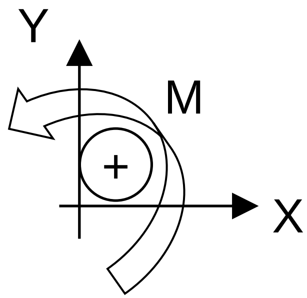


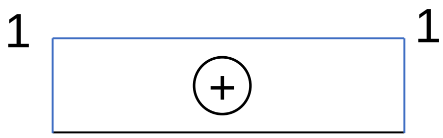
Using one of the equations of static equilibrium,

$$\Sigma F_y = 0$$

$$Or, R_{AV} - 1 = 0$$

$$\therefore R_{AV} = 1$$



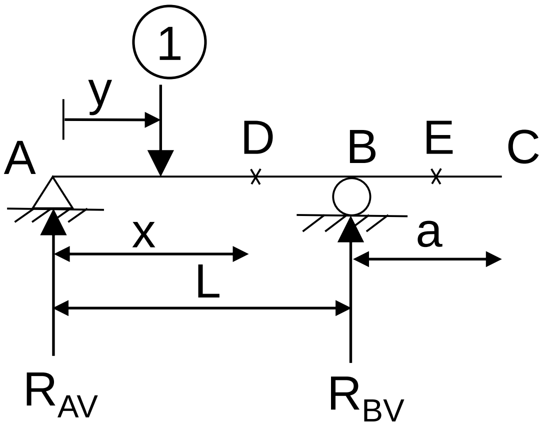


ILD for R_{AV}

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.5 Influence Lines for Support Reactions

[B] Single overhang beam:



Using equations of static equilibrium,

$$\Sigma F_y = 0$$

$$Or, R_{AV} - 1 + R_{BV} = 0$$

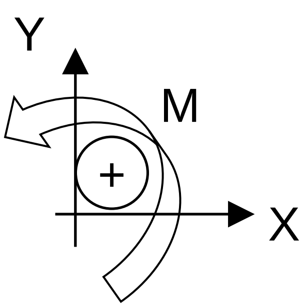
$$\therefore R_{AV} + R_{BV} = 1$$

$$\Sigma M_B = 0$$

$$Or, R_{AV} * L - 1 * (L - y) = 0$$

$$\therefore R_{AV} = 1 - \frac{y}{L}$$

$$\therefore R_{BV} = \frac{y}{L}$$



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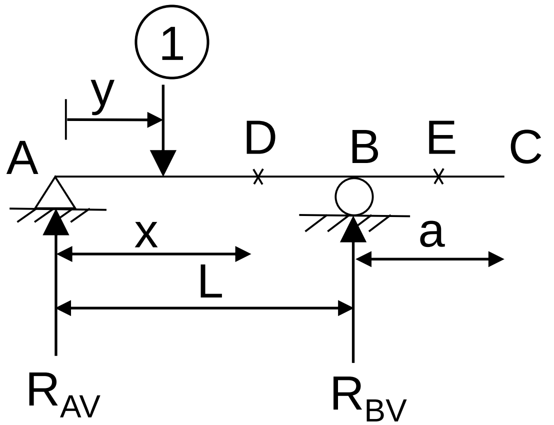
5.5 Influence Lines for Support Reactions

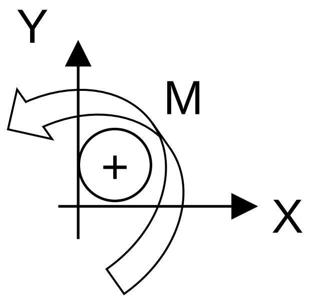
[B] Single overhang beam:



$$\therefore R_{AV} = 1 - \frac{y}{L}$$

$$\therefore R_{BV} = \frac{y}{L}$$

	R_{AV}	R_{BV}
y=0	1	0
y=x	$1 - \frac{x}{L}$	$\frac{x}{L}$
y=L	0	1
y=L+a	$-\frac{a}{L}$	$1 + \frac{a}{L}$



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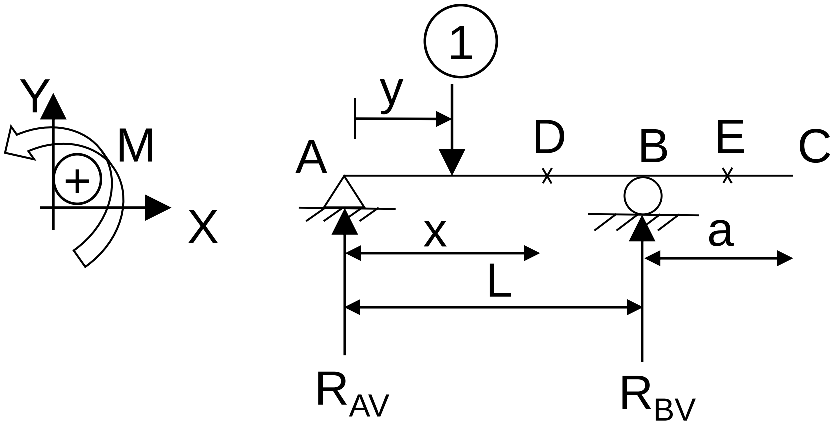
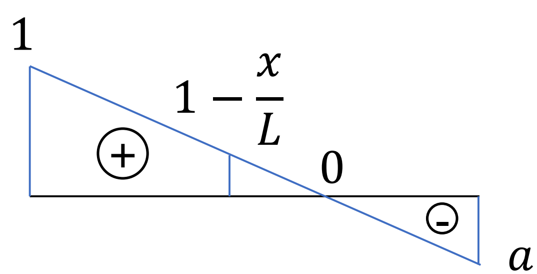
5.5 Influence Lines for Support Reactions

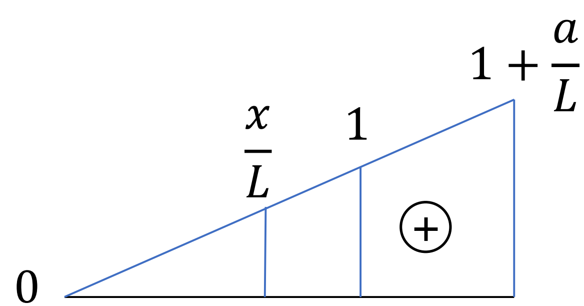
[B] Single overhang beam:



	R_{AV}	R_{BV}
y=0	1	0
y=x	$1 - \frac{x}{L}$	$\frac{x}{L}$
y=L	0	1
y=L+a	$-\frac{a}{L}$	$1 + \frac{a}{L}$



ILD for R_{AV}

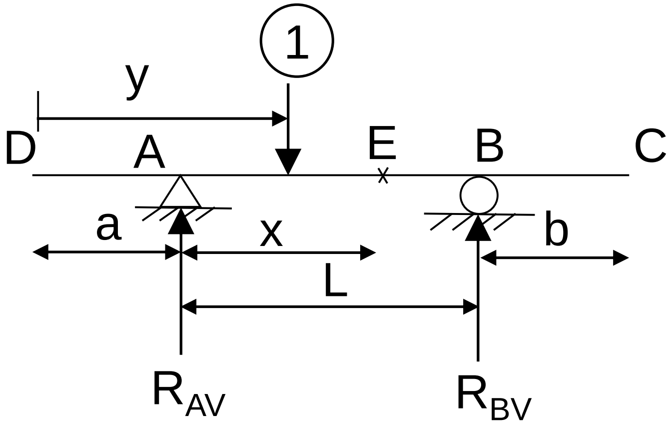


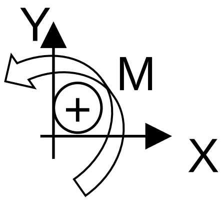
ILD for R_{BV}

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.5 Influence Lines for Support Reactions

[C] Double overhang beam:





Using equations of static equilibrium,

$$\Sigma F_y = 0$$

$$Or, R_{AV} - 1 + R_{BV} = 0$$

$$\therefore R_{AV} + R_{BV} = 1$$

$$\Sigma M_B = 0$$

$$Or, R_{AV} * L - 1 * (L + a - y) = 0$$

$$\therefore R_{AV} = \frac{L + a - y}{L}$$

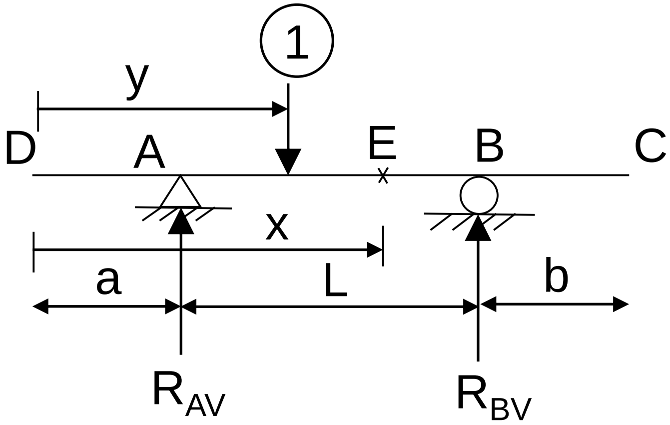
$$Or, R_{BV} = 1 - \frac{L + a - y}{L}$$

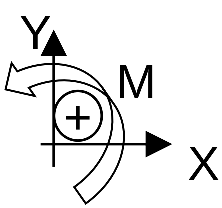
$$\therefore R_{BV} = \frac{y - a}{L}$$

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.5 Influence Lines for Support Reactions

[C] Double overhang beam:





$$\therefore R_{AV} = \frac{L + a - y}{L}$$

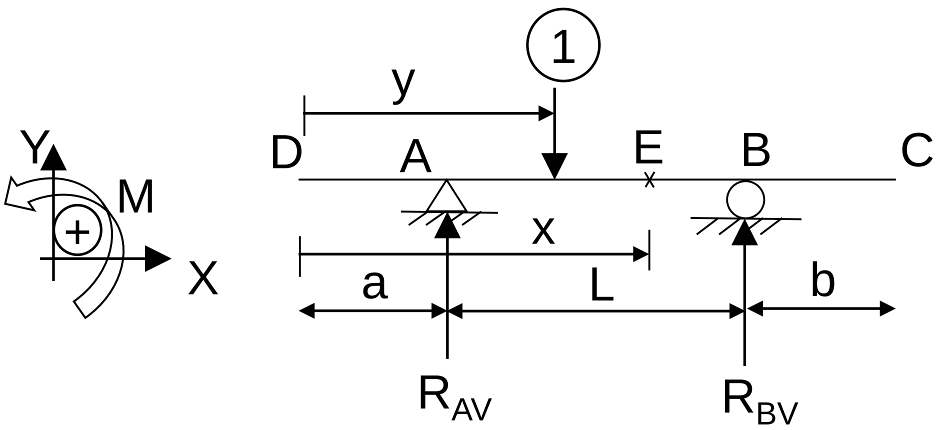
$$\therefore R_{BV} = \frac{y - a}{L}$$

	R_{AV}	R_{BV}
y=0	$\frac{L+a}{L}$	$-\frac{a}{L}$
y=a	1	0
y=x	$\frac{L+a-x}{L}$	$\frac{x-a}{L}$
y=L+a	0	1
y=L+a+b	$-\frac{b}{L}$	$\frac{L+b}{L}$

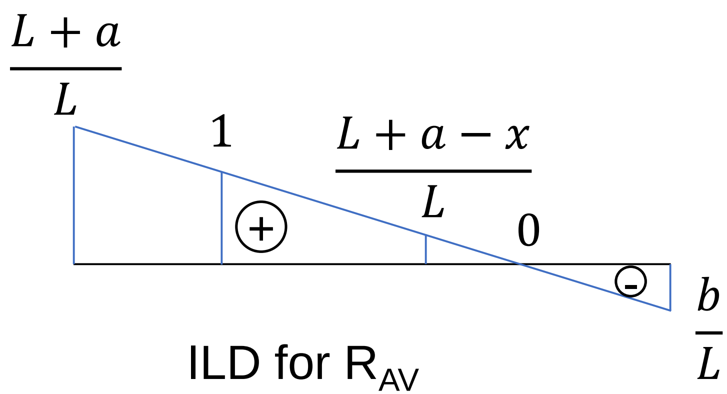
Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4^{th} ed.).New Delhi: Vikas Publishing House.

5.5 Influence Lines for Support Reactions

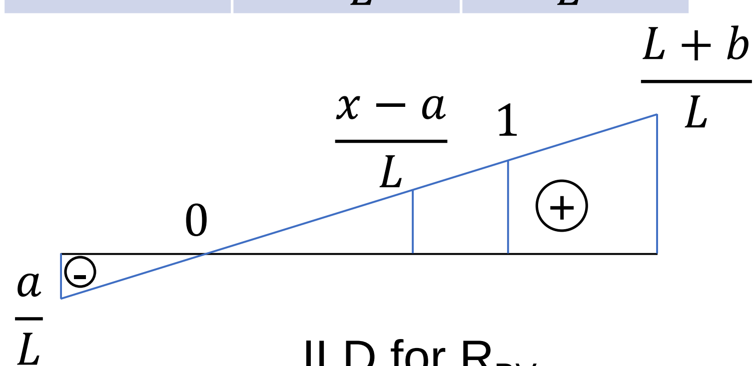
[C] Double overhang beam:



	R_{AV}	R_{BV}
y=0	$\frac{L+a}{L}$	$-\frac{a}{L}$
y=a	1	0
y=x	$\frac{L+a-x}{L}$	$\frac{x-a}{L}$
y=L+a	0	1
y=L+a+b	$-\frac{b}{L}$	$\frac{L+b}{L}$



ILD for R_{AV}

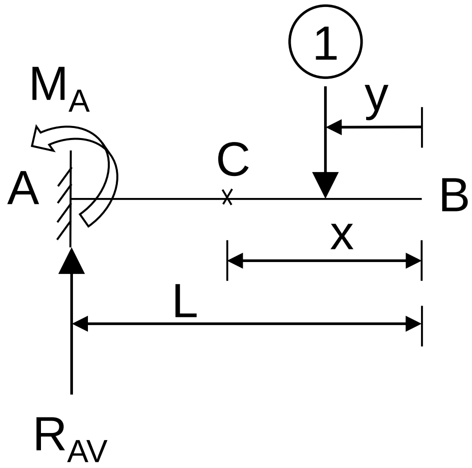


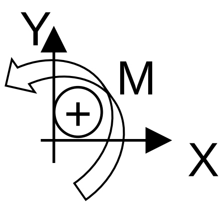
ILD for R_{BV}

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.6 Influence Lines for Support Moments

Cantilever beam:





Using equation of static equilibrium,

$$\Sigma M_B = 0$$

$$Or, M_A - R_{AV}L + 1 * y = 0$$

$$We\ have, R_{AV} = 1$$

$$Or, M_A - 1 * L + y = 0$$

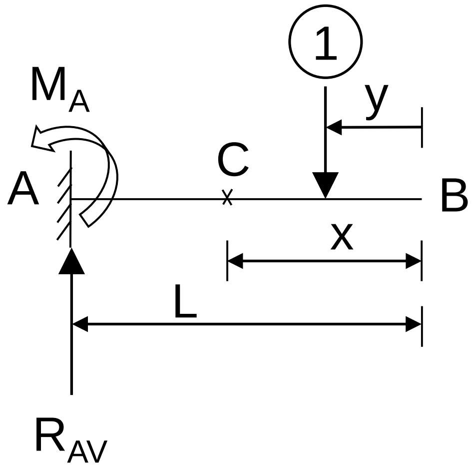
$$\therefore\ M_A = L - y$$

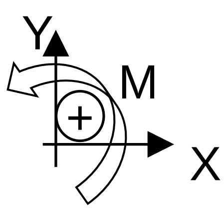
	$y = 0$	$y = x$	$y = L$
M_A	L	L-x	0

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.6 Influence Lines for Support Moments

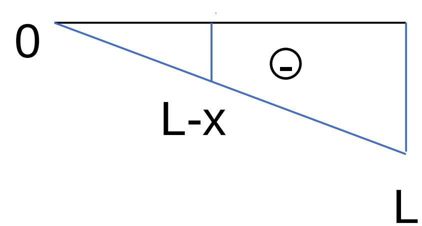
Cantilever beam:





$$\therefore \; M_A = L - y$$

	$y = \mathbf{0}$	$y = \mathbf{x}$	$y = \mathbf{L}$
M_A	L	L-x	0

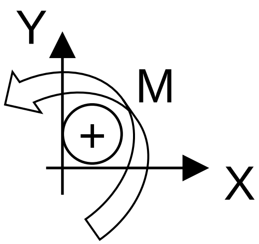


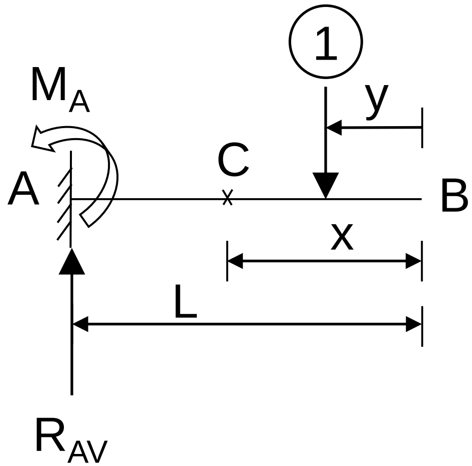
ILD for M_A

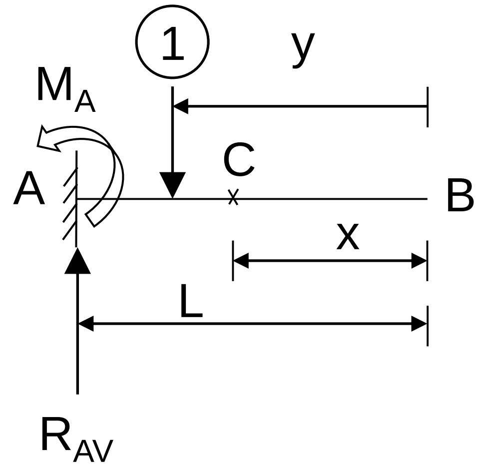
Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.7 Influence Lines for Shear Force

[A] Cantilever beam (SF at C):







We have,

$R_{AV} = 1$

$M_A = L - y$

(i) $0 \le y \le x$

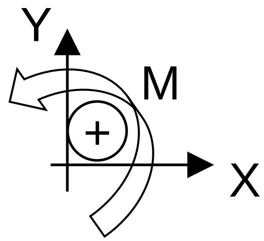
SF at C = 1

(ii) $x \le y \le L$

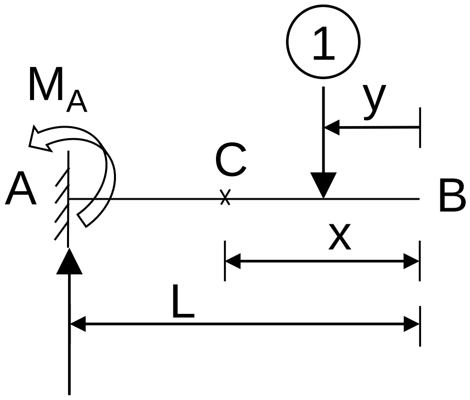
SF at C = 0

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.7 Influence Lines for Shear Force

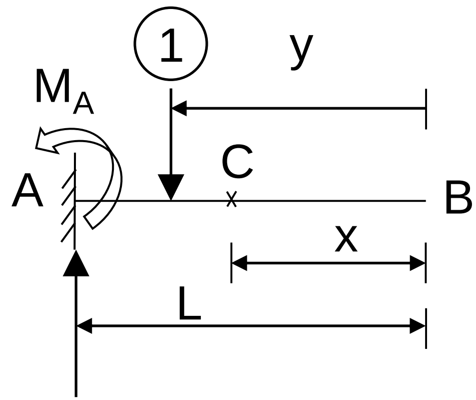


[A] Cantilever beam (SF at C):



R_{AV} (i) $0 \le y \le x$

SF at C = 1

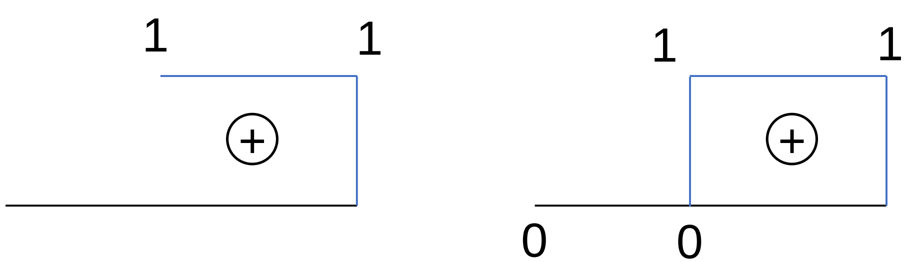


R_{AV} (ii) $x \le y \le L$

SF at C = 0

	$0 \le y \le x$	$x \le y \le L$
$y = 0$	1	-
$y = x$	1	0
$y = L$	-	0

Plotting the ordinates, we get

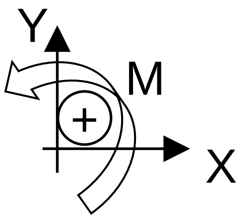


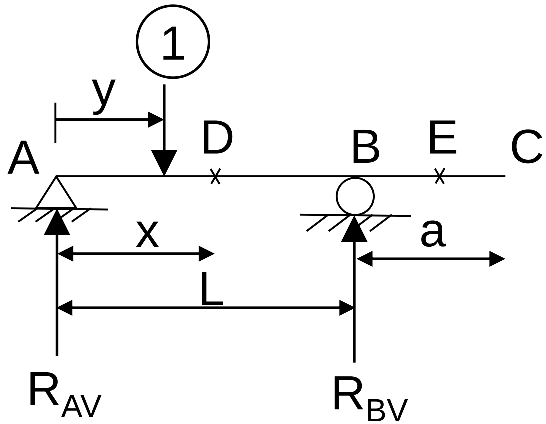
ILD for SF at C

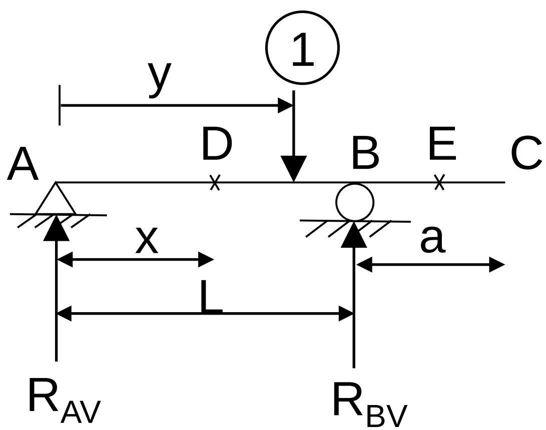
Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.7 Influence Lines for Shear Force

[B] Single Overhang Beam (SF at D):







We have,

$$R_{AV} = 1 - \frac{y}{L} \quad ; \; R_{BV} = \frac{y}{L}$$

(i) 0 ≤ y ≤ x

$$SF\ at\ D = R_{AV} - 1$$
$$= 1 - \frac{y}{L} - 1$$
$$= -\frac{y}{L}$$

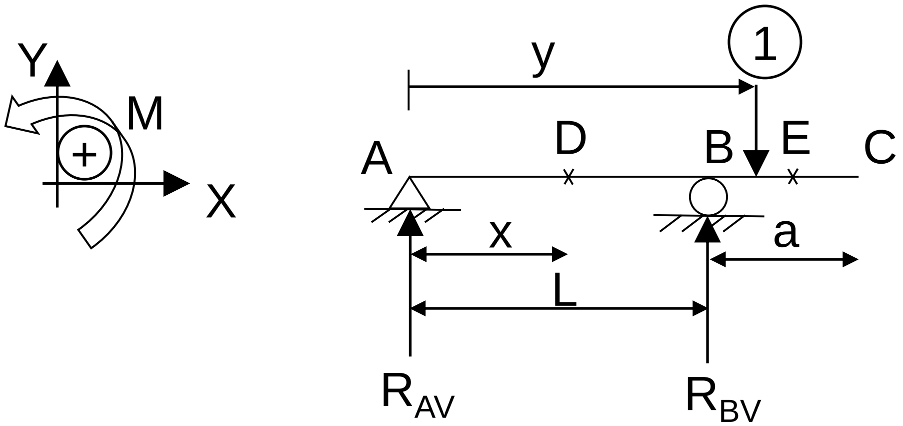
(ii) x ≤ y ≤ L

$$SF\ at\ D = R_{AV}$$
$$= 1 - \frac{y}{L}$$

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4^{th} ed.).New Delhi: Vikas Publishing House.

5.7 Influence Lines for Shear Force

[B] Single Overhang Beam (SF at D):



We have,

$$R_{AV} = 1 - \frac{y}{L} \quad ; \; R_{BV} = \frac{y}{L}$$

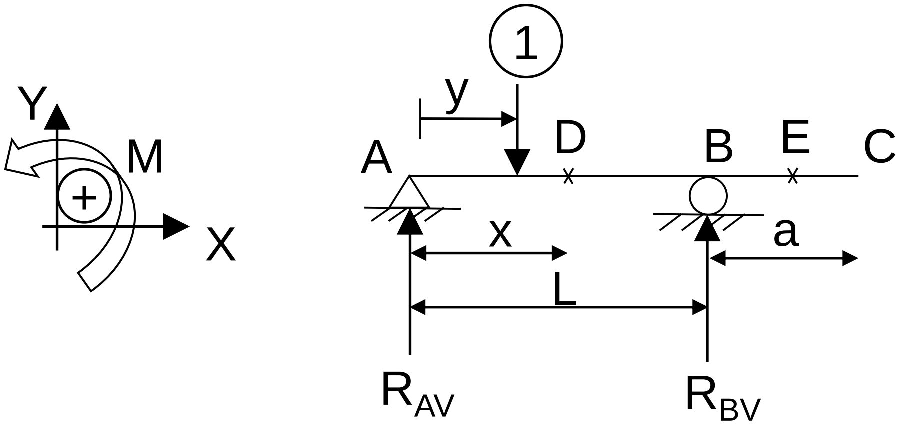
(iii) L ≤ y ≤ L+a

$$SF\ at\ D = R_{AV}$$
$$= 1 - \frac{y}{L}$$

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.7 Influence Lines for Shear Force

[B] Single Overhang Beam (SF at D):



We have,

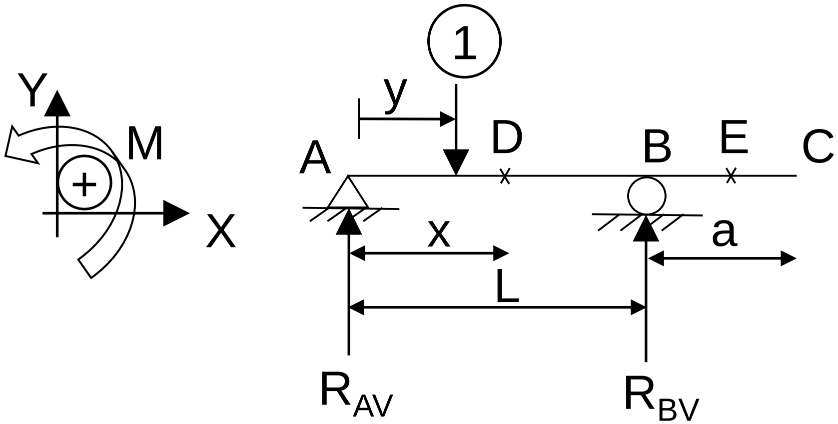
$$R_{AV} = 1 - \frac{y}{L} \quad ; \; R_{BV} = \frac{y}{L}$$

Unit load	SF at D	y=0	y=x	y=L	y=L+a
0 ≤ y ≤ x	$R_{AV} - 1 = -\frac{y}{L}$	0	$-\frac{x}{L}$	-	-
x ≤ y ≤ L	$R_{AV} = 1 - \frac{y}{L}$	-	$1 - \frac{x}{L}$	0	-
L ≤ y ≤ L+a	$R_{AV} = 1 - \frac{y}{L}$	-	-	0	$1 - \frac{L+a}{L} = -\frac{a}{L}$

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4^{th} ed.).New Delhi: Vikas Publishing House.

5.7 Influence Lines for Shear Force

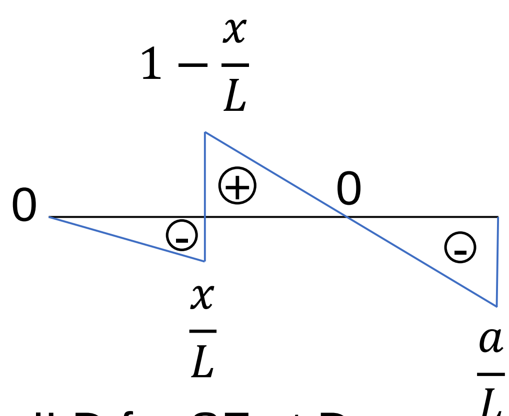
[B] Single Overhang Beam (SF at D):



We have,

$$R_{AV} = 1 - \frac{y}{L} \qquad ; \; R_{BV} = \frac{y}{L}$$

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.



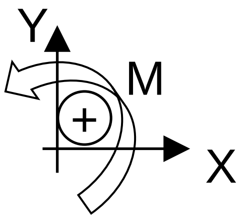
ILD for SF at D

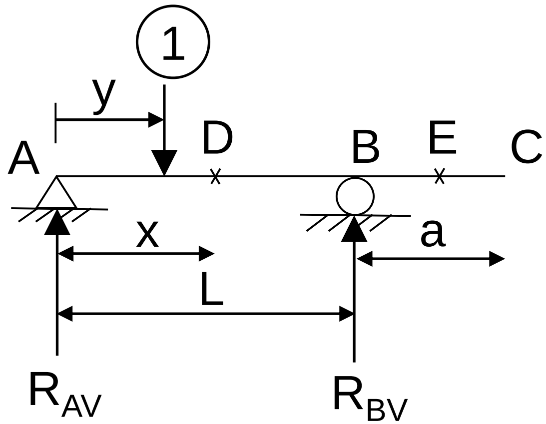
y=0	0		
y=x	$-\frac{x}{L}$	$1-\frac{x}{L}$	
y=L		0	0
y=L+a			$-\frac{a}{L}$

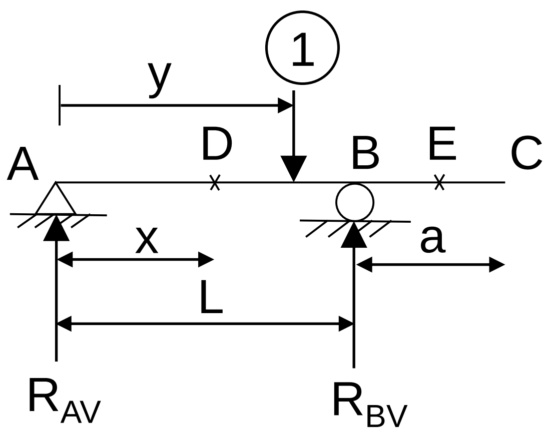
Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.7 Influence Lines for Shear Force

[B] Single Overhang Beam (SF at E):







We have,

$$R_{AV} = 1 - \frac{y}{L} \quad ; \; R_{BV} = \frac{y}{L}$$

(i) 0 ≤ y ≤ x

$$SF\ at\ E = R_{AV} - 1 + R_{BV}$$
$$= 1 - \frac{y}{L} - 1 + \frac{y}{L}$$
$$= 0$$

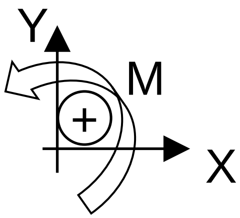
(ii) x ≤ y ≤ L

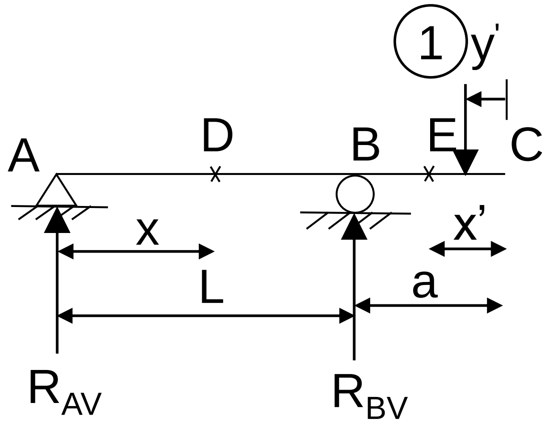
$$SF\ at\ E = R_{AV} - 1 + R_{BV}$$
$$= 1 - \frac{y}{L} - 1 + \frac{y}{L}$$
$$= 0$$

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.7 Influence Lines for Shear Force

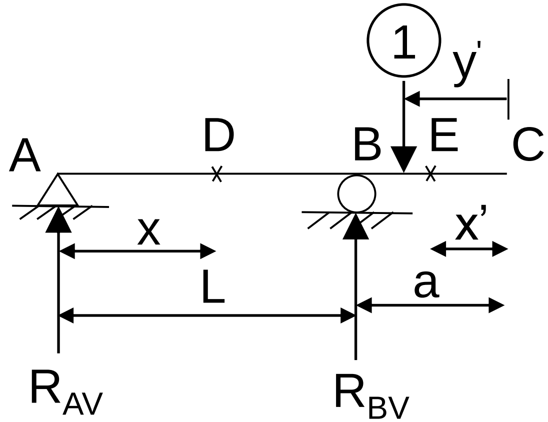
[B] Single Overhang Beam (SF at E):





(iii) 0 ≤ y' ≤ x'

$SF\ at\ E = 1$



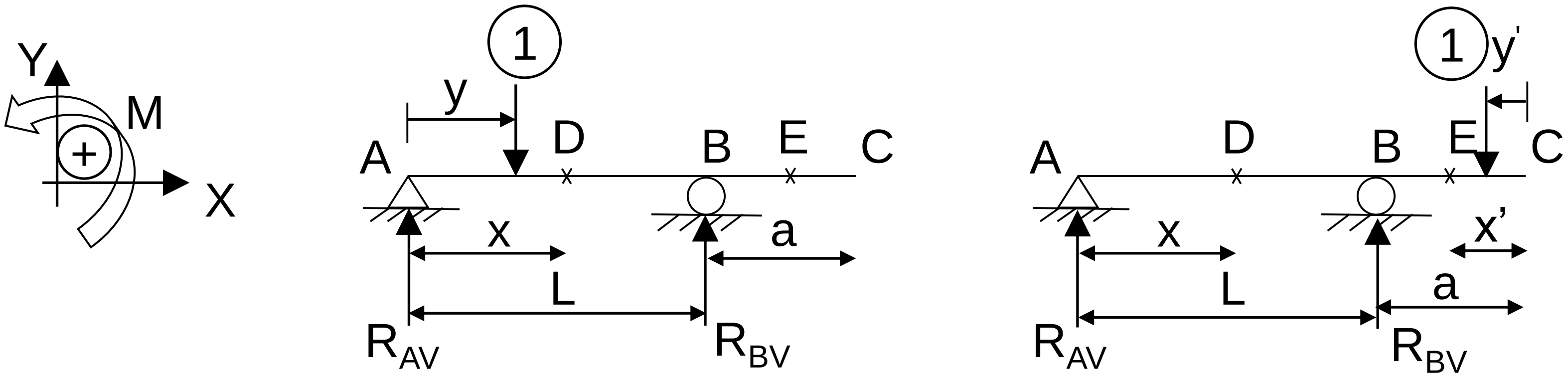
(iv) x' ≤ y' ≤ a

$SF\ at\ E = 0$

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.7 Influence Lines for Shear Force

[B] Single Overhang Beam (SF at E):

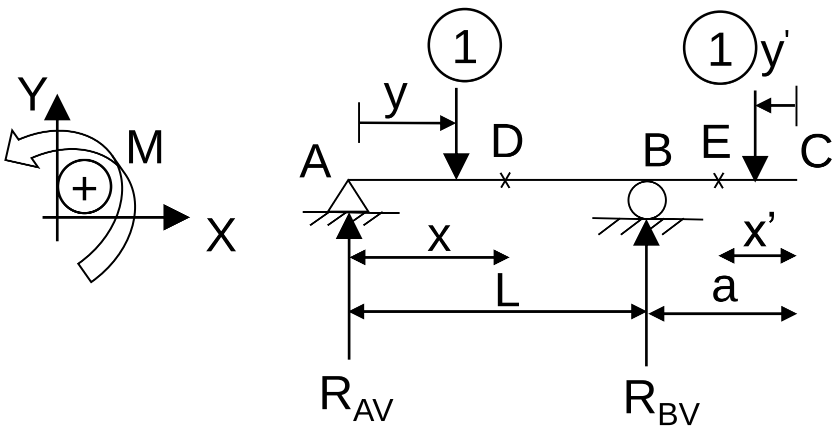


Unit load	SF at E	y=0	y=x	y=L	y'=0	y'=x'	y'=a
0 ≤ y ≤ x	0	0	0	-	-	-	-
x ≤ y ≤ L	0	-	0	0	-	-	-
0 ≤ y' ≤ x'	1	-	-	-	1	1	-
x' ≤ y' ≤ a	0	-	-	-	-	0	0

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.7 Influence Lines for Shear Force

[B] Single Overhang Beam (SF at E):



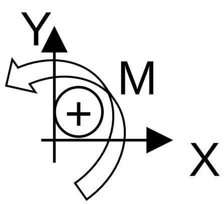
ILD for SF at E

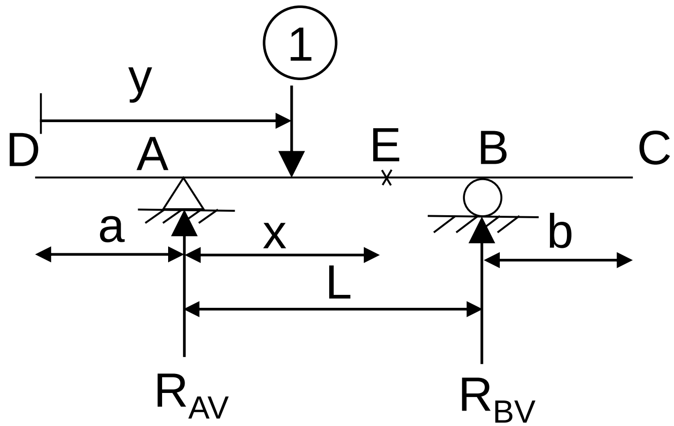
y=0	0			
y=x	0	0		
y=L		0		
y'=0			1	
y'=x'			1	0
y'=a				0

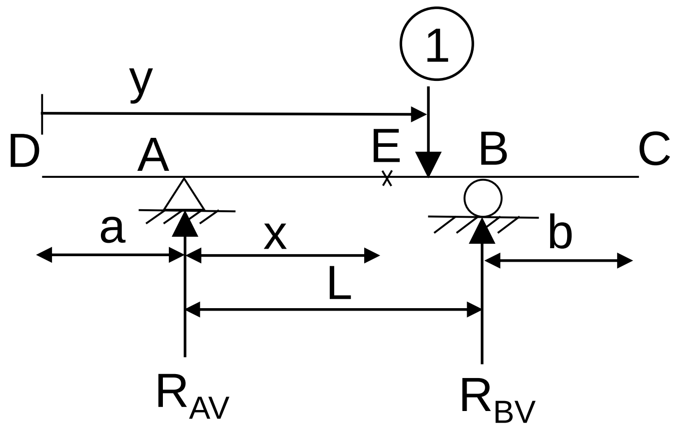
Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.7 Influence Lines for Shear Force

[C] Double Overhang Beam (SF at E):







We have,

$$\therefore R_{AV} = \frac{L + a - y}{L}$$

$$\therefore R_{BV} = \frac{y - a}{L}$$

(i) 0 ≤ y ≤ a+x

$$SF\ at\ E = R_{AV} - 1$$

$$= \frac{L+a-y}{L} - 1$$

$$= \frac{a - y}{L}$$

(ii) a+x ≤ y ≤ L+a

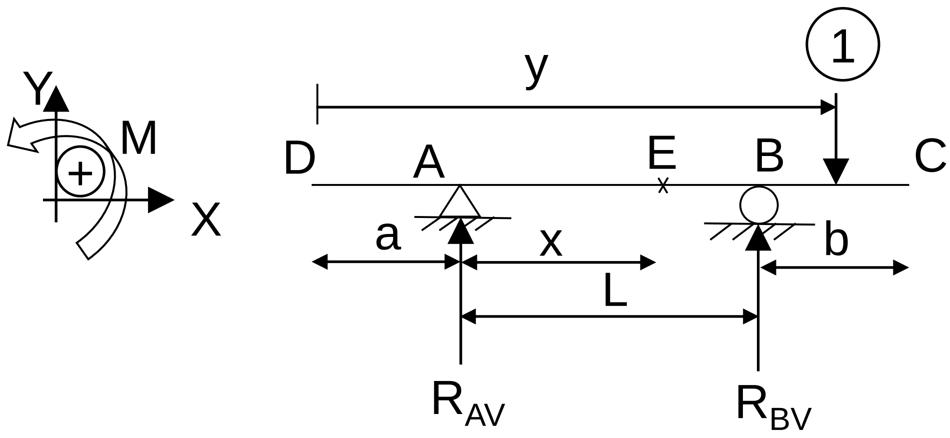
$$SF\ at\ E = R_{AV}$$

$$= \frac{L+a-y}{L}$$

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.7 Influence Lines for Shear Force

[C] Double Overhang Beam (SF at E):



We have,

$$\therefore R_{AV} = \frac{L+a-y}{L}$$

$$\therefore R_{BV} = \frac{y-a}{L}$$

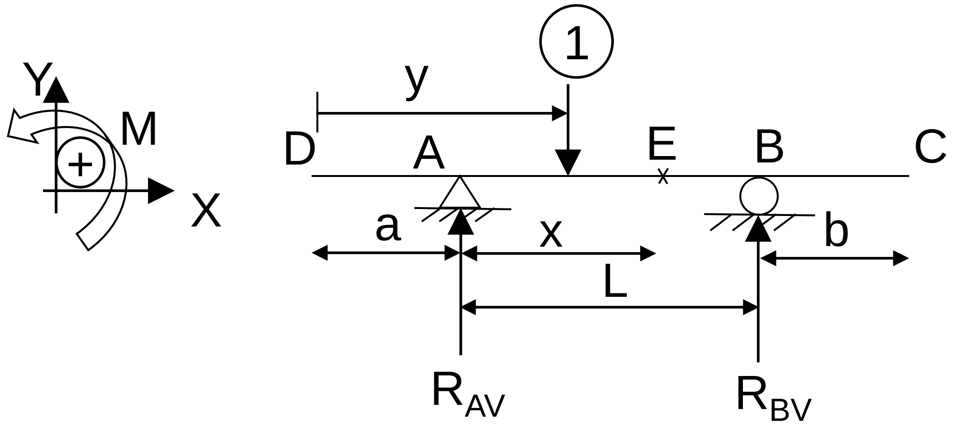
(iii) L+a ≤ y ≤ L+a+b

$$SF\ at\ E = R_{AV}$$

$$= \frac{L+a-y}{L}$$

5.7 Influence Lines for Shear Force

[C] Double Overhang Beam (SF at E):



We have,

$$R_{AV} = \frac{L+a-y}{L}$$

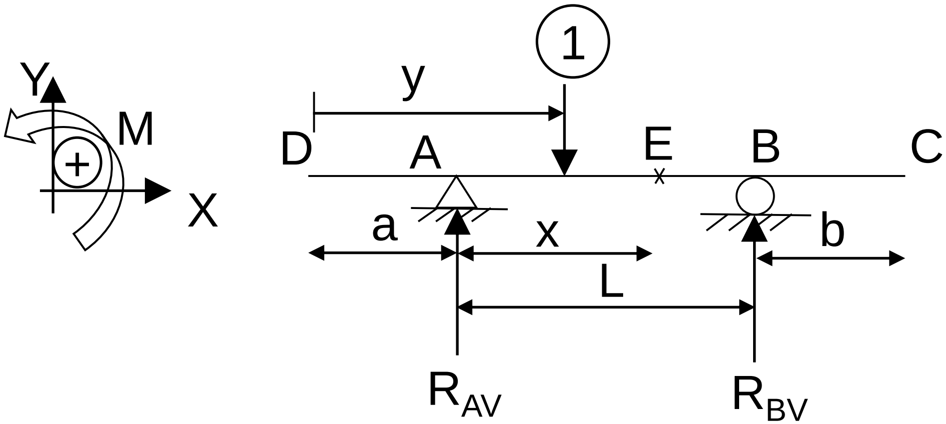
$$R_{BV} = \frac{y-a}{L}$$

Unit load	SF at E	y=0	y=a	y=a+x	y=L+a	y=L+a+b
$0 \le y \le a$	$\frac{a-y}{L}$	$\frac{a}{L}$	0	-	-	-
$a \le y \le x+a$	$\frac{a-y}{L}$	-	0	$-\frac{x}{L}$	-	-
$x+a \le y \le L+a$	$\frac{L+a-y}{L}$	-	-	$1-\frac{x}{L}$	0	-
$L+a \le y \le L+a+b$	$\frac{L+a-y}{L}$	-	-	-	0	$-\frac{b}{L}$

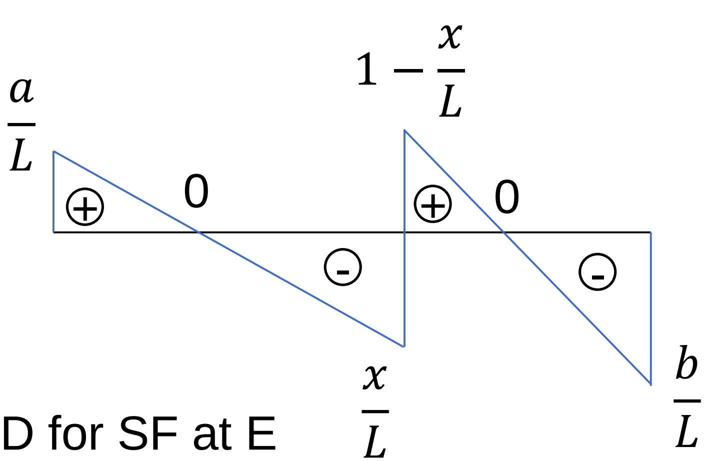
Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.7 Influence Lines for Shear Force

[C] Double Overhang Beam (SF at E):



y=0	$\frac{a}{L}$			
y=a	0	0		
y=a+x		$-\frac{x}{L}$	$1-\frac{x}{L}$	
y=L+a			0	0
y=L+a+b				$-\frac{b}{L}$

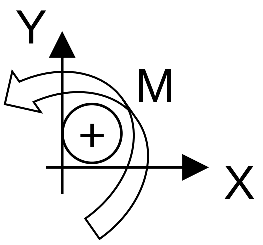


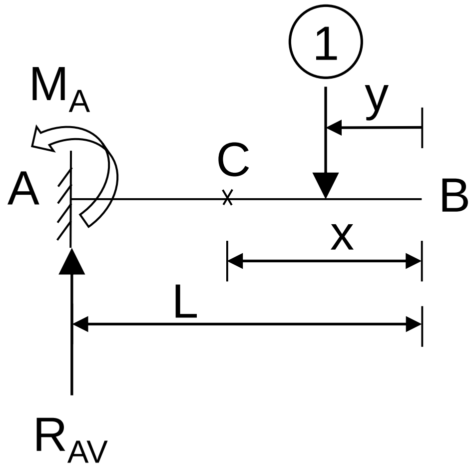
ILD for SF at E

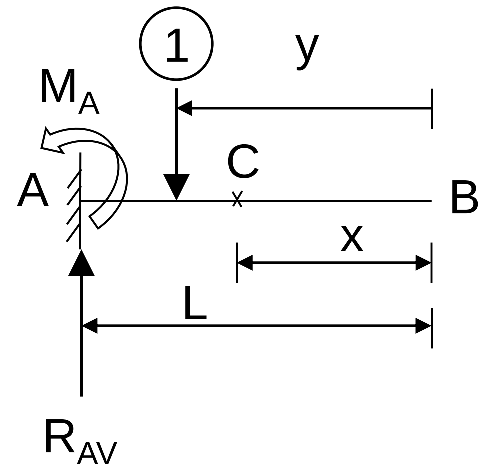
Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.8 Influence Lines for Bending Moment

[A] Cantilever beam (BM at C):







We have,

$R_{AV} = 1$

$M_A = L - y$

(i) 0 ≤ y ≤ x

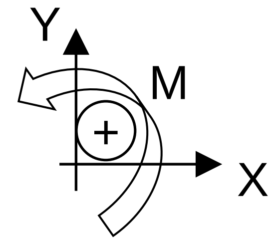
BM at C = y-x

(ii) x ≤ y ≤ L

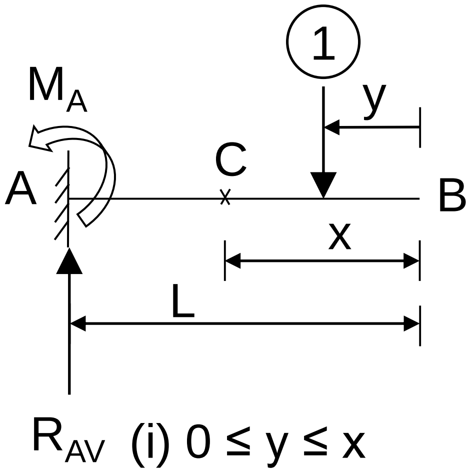
BM at C = 0

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.8 Influence Lines for Bending Moment

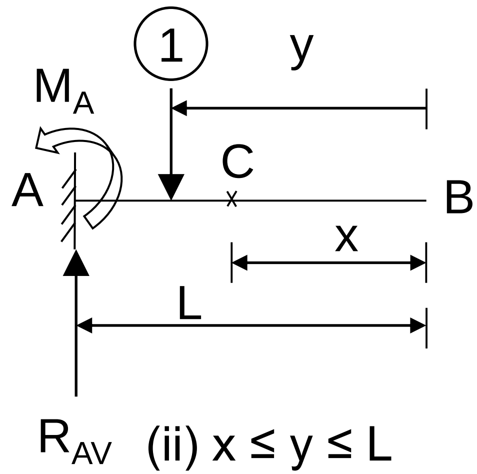


[A] Cantilever beam (BM at C):



(i) $0 \leq y \leq x$

BM at C = y-x

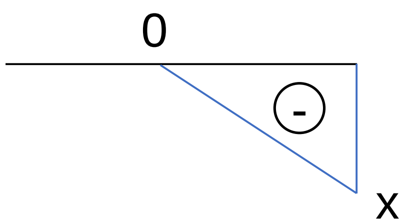


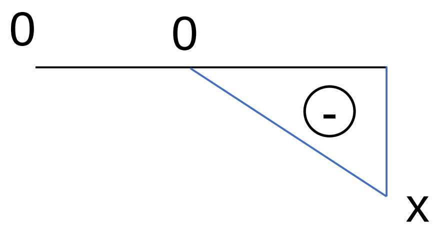
(ii) $x \leq y \leq L$

BM at C = 0

	$0 \leq y \leq x$	$x \leq y \leq L$
y = 0	-x	-
y = x	0	0
y = L	-	0

Plotting the ordinates, we get



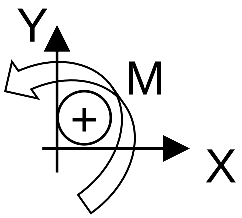


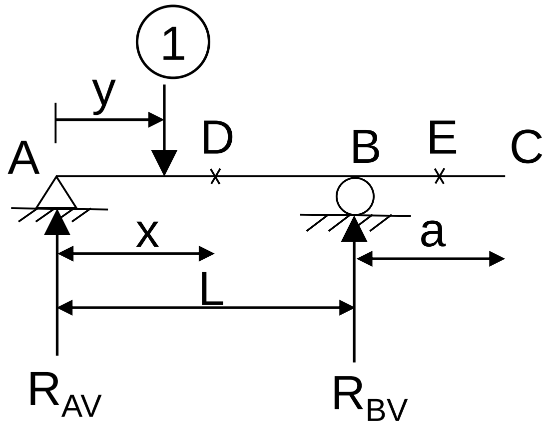
ILD for BM at C

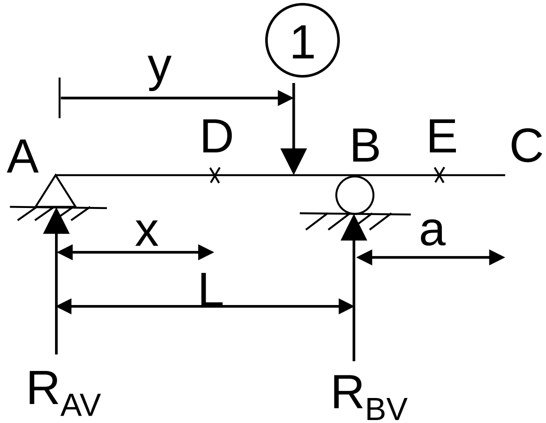
Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.8 Influence Lines for Bending Moment

[B] Single Overhang Beam (BM at D):







We have,

$$R_{AV} = 1 - \frac{y}{L} \quad ; \; R_{BV} = \frac{y}{L}$$

(i) 0 ≤ y ≤ x

$$BM\ at\ D = R_{AV} * x - 1 * (x - y)$$
$$= x - \frac{xy}{L} - \mathrm{x} + \mathrm{y}$$
$$= \frac{y(L - x)}{L}$$

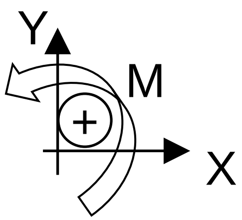
(ii) x ≤ y ≤ L

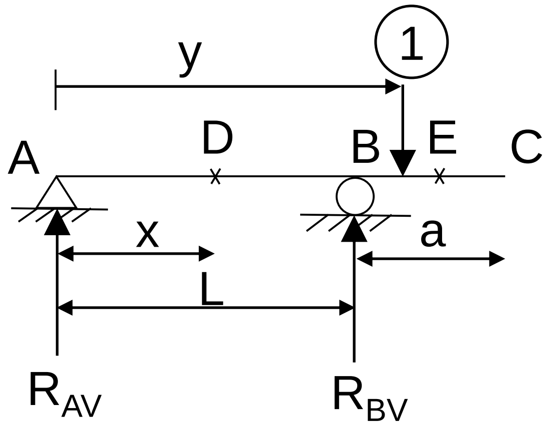
$$BM\ at\ D = R_{AV} * x$$
$$= x * \frac{(L-y)}{L}$$

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.8 Influence Lines for Bending Moment

[B] Single Overhang Beam (BM at D):





We have,

$$R_{AV} = 1 - \frac{y}{L} \quad ; \; R_{BV} = \frac{y}{L}$$

(iii) L ≤ y ≤ L+a

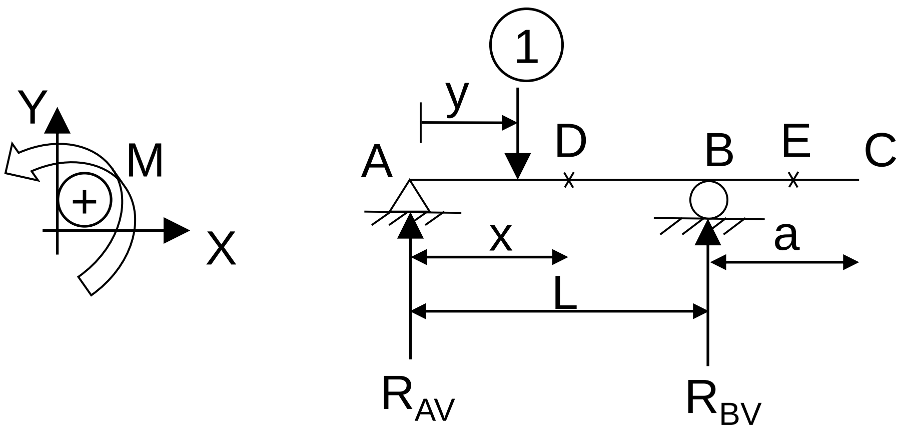
$$BM\ at\ D = R_{AV} * x$$

$$= x * \frac{(L-y)}{L}$$

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.8 Influence Lines for Bending Moment

[B] Single Overhang Beam (BM at D):



We have,

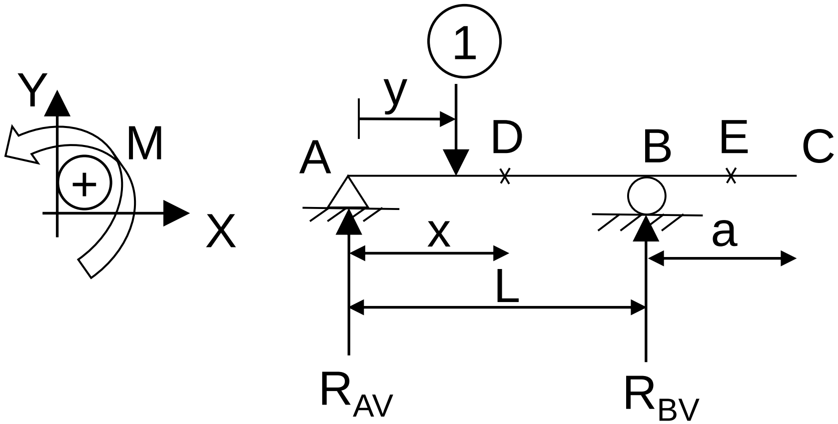
$$R_{AV} = 1 - \frac{y}{L} \quad ; \; R_{BV} = \frac{y}{L}$$

Unit load	BM at D	y=0	y=x	y=L	y=L+a
0 ≤ y ≤ x	$\frac{y(L-x)}{L}$	0	$\frac{x(L-x)}{L}$	-	-
x ≤ y ≤ L	$x * \frac{(L-y)}{L}$	-	$\frac{x(L-x)}{L}$	0	-
L ≤ y ≤ L+a	$x * \frac{(L-y)}{L}$	-	-	0	$x * \frac{(L-L-a)}{L} = -\frac{ax}{L}$

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.8 Influence Lines for Bending Moment

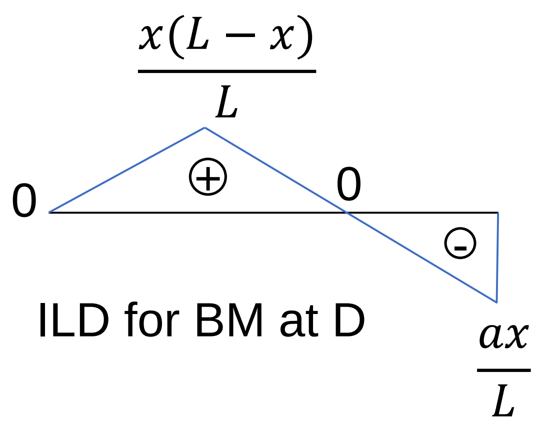
[B] Single Overhang Beam (BM at D):



We have,

$$R_{AV} = 1 - \frac{y}{L} \quad ; \; R_{BV} = \frac{y}{L}$$

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.



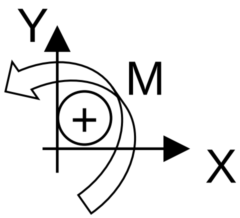
ILD for BM at D

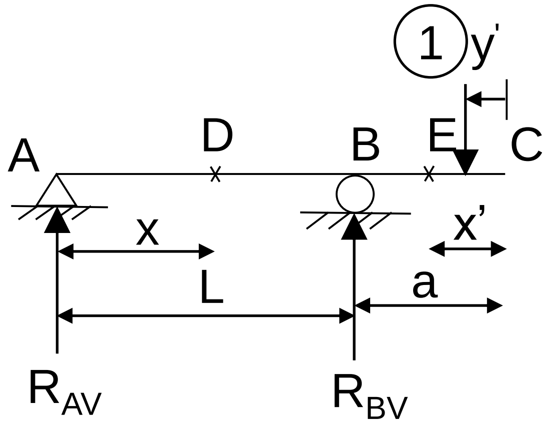
y=0	0		
y=x	$\frac{x(L-x)}{L}$	$\frac{x(L-x)}{L}$	
y=L		0	0
y=L+a			$-\frac{ax}{L}$

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.8 Influence Lines for Bending Moment

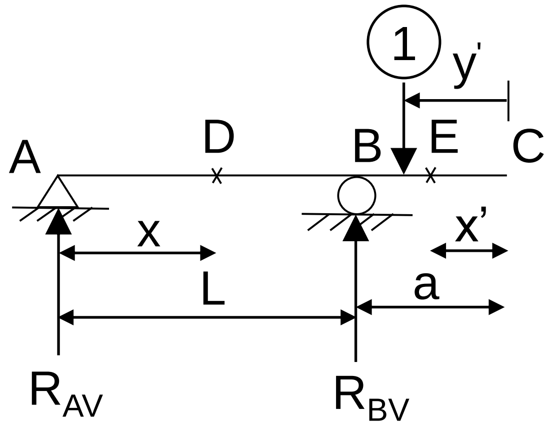
[B] Single Overhang Beam (BM at E):





(i) 0 ≤ y' ≤ x'

$$BM\ at\ E = y' - x'$$



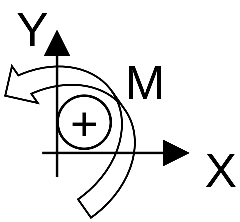
(ii) x' ≤ y' ≤ a

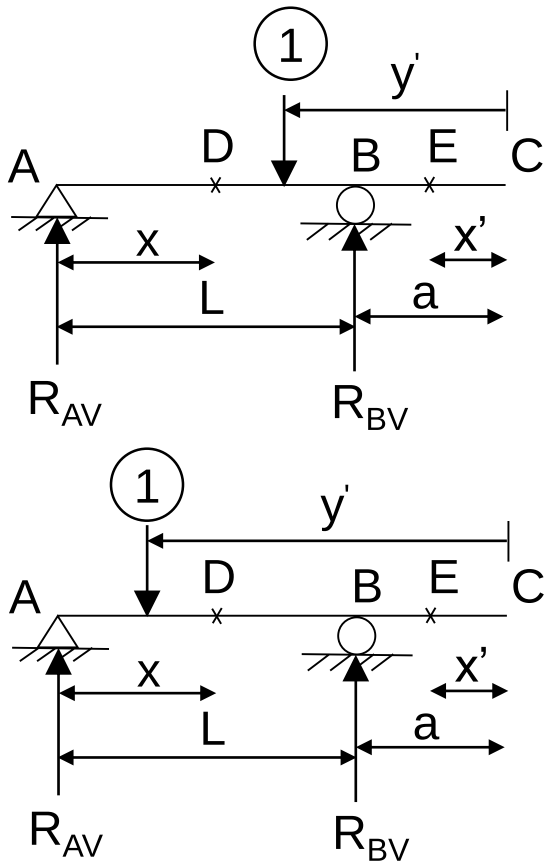
$$BM\ at\ E = 0$$

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.8 Influence Lines for Bending Moment

[B] Single Overhang Beam (BM at E):





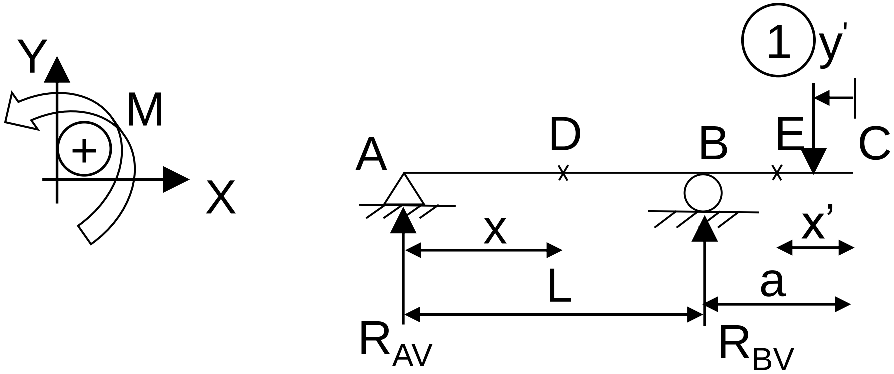
(iii) $a \leq y' \leq L+a$

$$BM\ at\ E = 0$$

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.8 Influence Lines for Bending Moment

[B] Single Overhang Beam (BM at E):

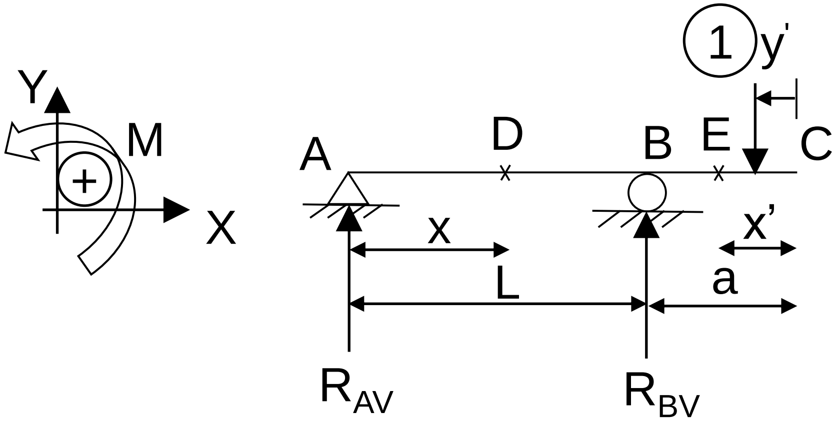


Unit load	SF at E	y'=0	y'=x'	y'=a	y'=L+a
0 ≤ y' ≤ x'	y'-x'	-x'	0	-	-
x' ≤ y ≤ a	0	-	0	0	-
a ≤ y' ≤ L+a	0	-	-	0	0

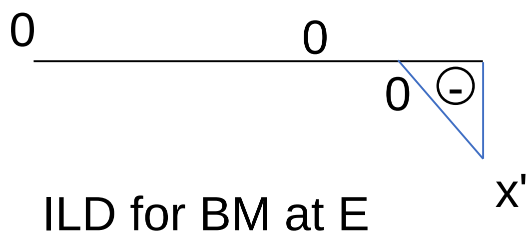
Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.8 Influence Lines for Bending Moment

[B] Single Overhang Beam (BM at E):



y'=0	-x'			
y'=x'	0	0		
y'=a		0	0	
y'=L+a			0	0

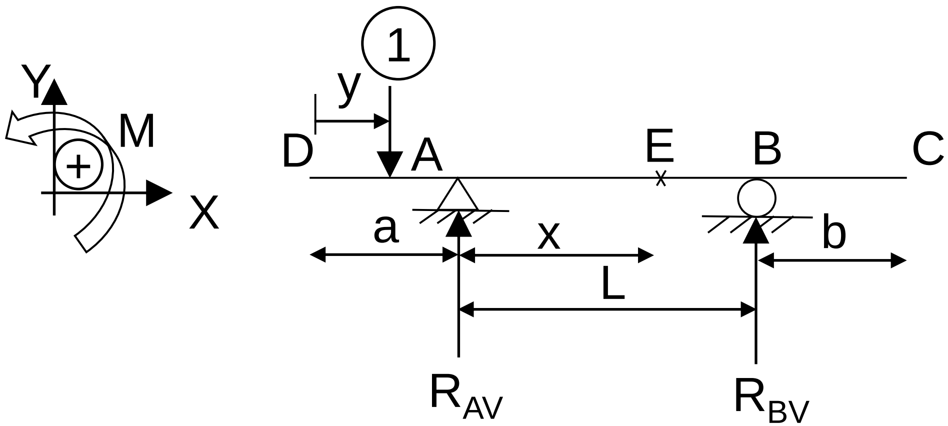


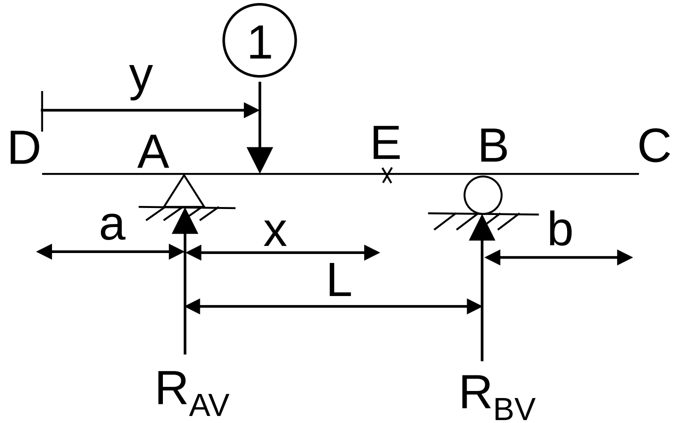
ILD for BM at E

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.8 Influence Lines for Bending Moment

[C] Double Overhang Beam (BM at E):





We have,

$$\therefore R_{AV} = \frac{L+a-y}{L}$$

$$\therefore R_{BV} = \frac{y-a}{L}$$

(i) 0 ≤ y ≤ a

$$BM\ at\ E\ = R_{AV} * x - 1 * (x + a - y)$$

$$= x + \frac{x(a-y)}{L} - \mathrm{x} - \mathrm{a} + \mathrm{y}$$

$$= \frac{(a-y)(x-L)}{L}$$

(ii) a ≤ y ≤ a+x

$$BM\ at\ E\ = R_{AV} * x - 1 * (x + a - y)$$

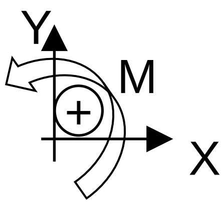
$$= x + \frac{x(a-y)}{L} - \mathrm{x} - \mathrm{a} + \mathrm{y}$$

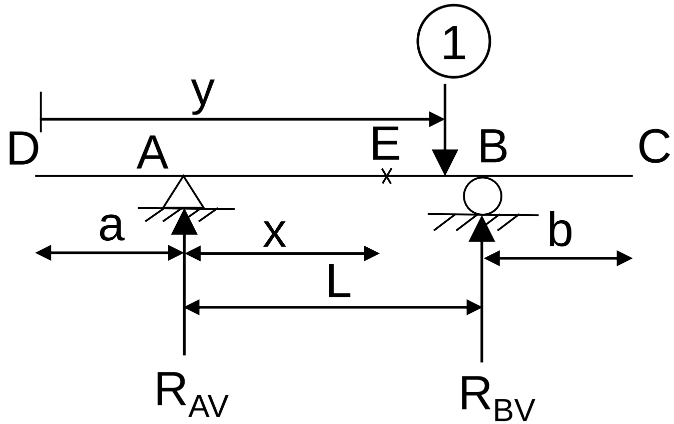
$$= \frac{(a-y)(x-L)}{L}$$

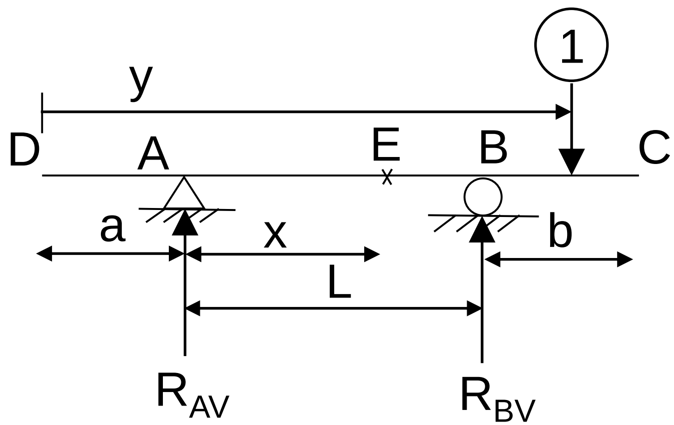
Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.8 Influence Lines for Bending Moment

[C] Double Overhang Beam (BM at E):







We have,

$$\therefore R_{AV} = \frac{L + a - y}{L}$$

$$\therefore R_{BV} = \frac{y - a}{L}$$

(iii) a+x ≤ y ≤ L+a

$$BM\ at\ E = R_{AV} * x$$

$$= \frac{x(L + a - y)}{L}$$

(iv) L+a ≤ y ≤ L+a+b

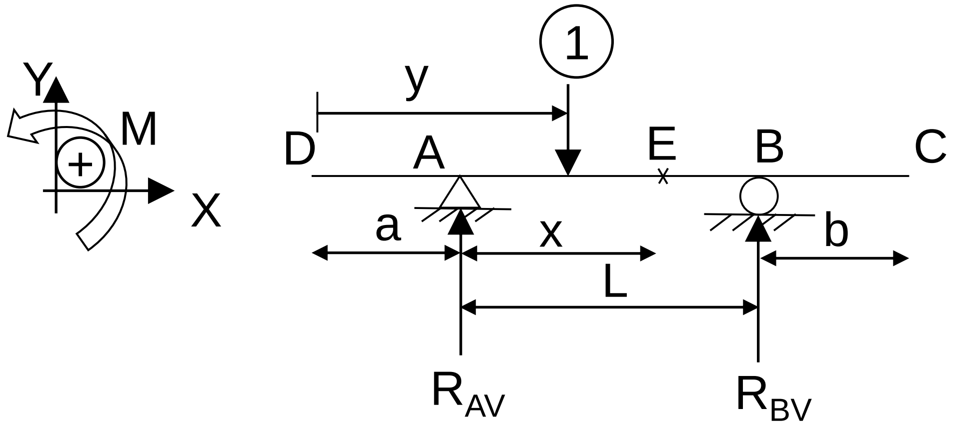
$$BM\ at\ E = R_{AV} * x$$

$$= \frac{x(L + a - y)}{L}$$

Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.8 Influence Lines for Bending Moment

[C] Double Overhang Beam (BM at E):



We have,

$$R_{AV} = \frac{L+a-y}{L}$$

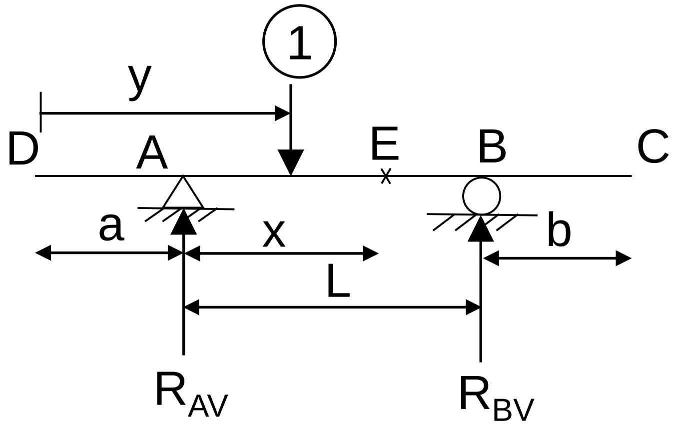
$$R_{BV} = \frac{y-a}{L}$$

Unit load	BM at E	y=0	y=a	y=a+x	y=L+a	y=L+a+b
0 ≤ y ≤ a	$\frac{(a-y)(x-L)}{L}$	$-\frac{a(L-x)}{L}$	0	-	-	-
a≤ y ≤ x+a	$\frac{(a-y)(x-L)}{L}$	-	0	$\frac{x(L-x)}{L}$	-	-
x+a ≤ y ≤ L+a	$\frac{x(L+a-y)}{L}$	-	-	$\frac{x(L-x)}{L}$	0	-
L+a ≤ y ≤L+a+b	$\frac{x(L+a-y)}{L}$	-	-	-	0	$-\frac{bx}{L}$

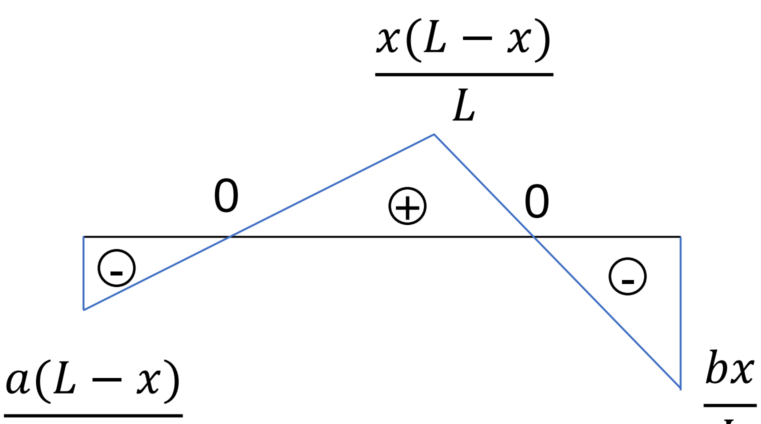
Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

5.8 Influence Lines for Bending Moment

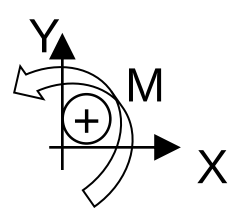
[C] Double Overhang Beam (BM at E):



y=0	$-\frac{a(L-x)}{L}$			
y=a	0	0		
y=a+x		$\frac{x(L-x)}{L}$	$\frac{x(L-x)}{L}$	
y=L+a			0	0
y=L+a+b				$-\frac{bx}{L}$



ILD for BM at E



Source: Bhavikatti, S. S. (2011). *Structural Analysis –I* (4th ed.).New Delhi: Vikas Publishing House.

-------------End of Lecture#8------------------

-------------End of Part II of III for Chapter5--------------

References

[1] Bhavikatti, S. S. (2011). *Structural Analysis –I* (4^{th} ed.).New Delhi: Vikas Publishing House.