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CLASSIFICATION OF FIRE RESISTANCE IN ACCORDANCE WITH EN 13501-2:2007

(English Version)

Sponsor:	**SOUDAL Sp. z o.o.** **ul. Gdańska 7** **Czosnów Mazowiecki** **05-152 Czosnów**
Prepared by:	**Fire Research Department** **Building Research Institute** **Filtrowa St. 1** **PL 00-611 Warsaw**
Product name:	**Linear joint seals**
Classification report No.:	**NP-02491.2/2009/MŁ**
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This classification report consists of seventeen pages and may only be used or reproduced in its entirety. Appendix No. 1 to this classification report consists of twenty one pages.

1. Introduction

This classification report defines the resistance to fire classification assigned to the elements – SOUDAL linear joint seals in accordance with the procedures given in EN 13501-2:2007.

2. Details of classified product

2.1. General

The element, SOUDAL linear joint seal is defined as horizontal linear joints seals in horizontal building supporting construction.

2.2. Description

The element, linear joint seals of SOUDAL Company is fully described below.

Linear joint seals are made of:

- SOUDASEAL FR - neutral, elastic, one-component sealant based on hybrid polymer technology,
- PU BACKING ROD,
- FIRESILICONE FR - neutral, elastic, one-component sealant based on silicones,
- FIRECRYL FR - plasto-elastic one-component joint sealant based on acrylic dispersion,
- SOUDAFOAM FR - one-component, selfexpanding, ready to use polyurethane foam with propellants which are completely harmless to the ozone layer,
- MINERAL WOOL 80 – stone mineral wool plates - wool density 80 kg/m^3.

Details of the joint seals constructions are shown in figures No. 1-14 in Appendix 1.

3. Test reports/extended application reports and test results in support of the classification

3.1. Test reports/extended application reports

Name of Laboratory	Name of sponsor	Report ref. no	Test method
Fire Research Laboratory of Building Research Institute	SOUDAL Sp. z o.o.	LP-02491.2/09	EN 1366-4:2006

3.2. Test results

Test method, number and date	Parameter	Results
EN 1366-4:2006 LP-02491.2/09 02.02.2010	Linear joint seal **Type A – see Fig. 1a) in Appendix 1** Orientation – horizontal joint in horizontal building supporting construction - width of joint – **W = 30 mm**	
	supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
	integrity	
	cotton pad	135 minutes no failure
	gap gauges	135 minutes no failure
	sustained flaming	135 minutes no failure
	insulation	135 minutes no failure
	Linear joint seal **Type B – see Fig. 2a) in Appendix 1** Orientation – horizontal joint in horizontal building supporting construction - width of joint – **W = 20 mm**	
	supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
	integrity	
	cotton pad	135 minutes no failure
	gap gauges	135 minutes no failure
	sustained flaming	135 minutes no failure
	insulation	135 minutes no failure
	Linear joint seal **Type C – see Fig. 3a) in Appendix 1** Orientation – horizontal joint in horizontal building supporting construction - width of joint – **W = 25 mm**	
	supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
	integrity	
	cotton pad	135 minutes no failure
	gap gauges	135 minutes no failure
	sustained flaming	135 minutes no failure
	insulation	120 minutes
	Linear joint seal **Type D – see Fig. 4a) in Appendix 1** Orientation – horizontal joint in horizontal building supporting construction - width of joint – **W = 40 mm**	
	supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
	integrity	
	cotton pad	135 minutes no failure
	gap gauges	135 minutes no failure

sustained flaming	135 minutes no failure
insulation	135 minutes no failure
Linear joint seal **Type D' – see Fig. 4a) in Appendix 1** Orientation – horizontal joint in horizontal building supporting construction - width of joint – **W = 50 mm**	
supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
integrity	
cotton pad	135 minutes no failure
gap gauges	135 minutes no failure
sustained flaming	135 minutes no failure
insulation	135 minutes no failure
Linear joint seal **Type E – see Fig. 5b) in Appendix 1** Orientation – horizontal floor joint abutting a wall - width of joint – **W = 40 mm**	
supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
integrity	
cotton pad	135 minutes no failure
gap gauges	135 minutes no failure
sustained flaming	135 minutes no failure
insulation	135 minutes no failure
Linear joint seal **Type E' – see Fig. 6b) in Appendix 1** Orientation – horizontal floor joint abutting a wall - width of joint – **W = 30 mm**	
supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
integrity	
cotton pad	102 minutes no failure
gap gauges	102 minutes no failure
sustained flaming	102 minutes
insulation	102 minutes no failure
Linear joint seal **Type E'' – see Fig. 6b) in Appendix 1** Orientation – horizontal floor joint abutting a wall - width of joint – **W = 40 mm**	
supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
integrity	
cotton pad	88 minutes no failure
gap gauges	88 minutes
sustained flaming	88 minutes no failure
insulation	84 minutes
Linear joint seal **Type F – see Fig. 7b) in Appendix 1** Orientation – horizontal joint in horizontal building supporting construction - width of joint – **W = 30 mm**	

supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
integrity	
cotton pad	135 minutes no failure
gap gauges	135 minutes no failure
sustained flaming	135 minutes no failure
insulation	135 minutes no failure

Linear joint seal **Type G – see Fig. 8b) in Appendix 1**
Orientation – horizontal joint in horizontal building supporting construction
- width of joint – **W = 20 mm**

supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
integrity	
cotton pad	135 minutes no failure
gap gauges	135 minutes no failure
sustained flaming	135 minutes no failure
insulation	128 minutes

Linear joint seal **Type H – see Fig. 9a) in Appendix 1**
Orientation – horizontal joint in horizontal building supporting construction
- width of joint – **W = 60 mm**

supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
integrity	
cotton pad	135 minutes no failure
gap gauges	135 minutes no failure
sustained flaming	135 minutes no failure
insulation	135 minutes no failure

Linear joint seal **Type H' – see Fig. 10 in Appendix 1**
Orientation – horizontal floor joint abutting a wall
- width of joint – **W = 40 mm**

supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
integrity	
cotton pad	135 minutes no failure
gap gauges	135 minutes no failure
sustained flaming	135 minutes no failure
insulation	135 minutes no failure

Linear joint seal **Type H'' – see Fig. 10 in Appendix 1**
Orientation – horizontal floor joint abutting a wall
- width of joint – **W = 60 mm**

supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
integrity	
cotton pad	129 minutes no failure
gap gauges	129 minutes no failure

sustained flaming	129 minutes
insulation	129 minutes no failure

Linear joint seal **Type I – see Fig. 11b) in Appendix 1**
Orientation – horizontal joint in horizontal building supporting construction
- width of joint – **W = 100 mm**

supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
integrity	
cotton pad	135 minutes no failure
gap gauges	135 minutes no failure
sustained flaming	135 minutes no failure
insulation	135 minutes no failure

Linear joint seal **Type T – see Fig. 12b) in Appendix 1**
Orientation – horizontal joint in horizontal building supporting construction
- width of joint – **W = 40 mm**

supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
integrity	
cotton pad	135 minutes no failure
gap gauges	135 minutes no failure
sustained flaming	135 minutes no failure
insulation	135 minutes no failure

Linear joint seal **Type W – see Fig. 13a) in Appendix 1**
Orientation – horizontal joint in horizontal building supporting construction
- width of joint – **W = 30 mm**

supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
integrity	
cotton pad	135 minutes no failure
gap gauges	135 minutes no failure
sustained flaming	106 minutes
insulation	106 minutes

Linear joint seal **Type W – see Fig. 13a) in Appendix 1**
Orientation – horizontal joint in horizontal building supporting construction
- width of joint – **W = 20 mm**

supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
integrity	
cotton pad	135 minutes no failure
gap gauges	135 minutes no failure
sustained flaming	135 minutes no failure
insulation	135 minutes no failure

Linear joint seal **Type Z – see Fig. 14a) in Appendix 1**
Orientation – horizontal joint in horizontal building supporting construction
- width of joint – **W = 30 mm**

	supporting construction	**G = 15 cm** thick floor made of aerated concrete slabs
	integrity	
	cotton pad	135 minutes no failure
	gap gauges	135 minutes no failure
	sustained flaming	135 minutes no failure
	insulation	100 minutes

4. Classification and field of application

4.1. Reference of classification

This classification has been carried out in accordance with Clause 7 of EN 13501-2:2007.

4.2. Classification

The element, SOUDAL linear joint seals is classified according to the following combinations of performance parameters and classes as appropriate.

*) Key:
E - fire integrity
I - fire insulation
H - orientation: horizontal construction – horizontal joint
T - orientation: vertical construction – horizontal joint
X - movement capacity – no movement
F - type of splices - field
W - joint widths range (in mm)

4.2.1.1. Linear joint seal **Type A see Fig. 1a) in Appendix 1**

– joint width from **0** to **30 mm**

– minimum floor thickness – **15cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – H – X – F – W 0 to 30 *)

4.2.1.2. Linear joint seal **Type B see Fig. 2a) and 2b) in Appendix 1**

– joint width from **0** to **20 mm**

– minimum floor thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120 =	120												

Resistance to fire class: EI 120 – H – X – F – W 0 to 20 *)

4.2.1.3. Linear joint seal **Type C see Fig. 3a) and 3b) in Appendix 1**

– joint width from **0** to **25 mm**

– minimum floor thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – V – X – F – W 0 to 25 *)

4.2.1.4. Linear joint seal **Type D see Fig. 4a) in Appendix 1**

– joint width from **0** to **50 mm**

– minimum floor thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – H – X – F – W 0 to 50 *)

4.2.1.5. Linear joint seal **Type E see Fig. 5a) and 5b) in Appendix 1**

– joint width from **0** to **40 mm**

– minimum floor thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

*)

Resistance to fire class: EI 120– H – X – F – W 0 to 40

4.2.1.6. Linear joint seal **Type F see Fig. 7a) and 7b) in Appendix 1**

– joint width from **0** to **30 mm**

– minimum floor thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120– H – X – F – W 0 to 30 *)

4.2.1.7. Linear joint seal **Type G see Fig. 8a) and 8b) in Appendix 1**

– joint width from **0** to **20 mm**

– minimum floor thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – H – X – F – W 0 to 20 *)

4.2.1.8. Linear joint seal **Type H see Fig. 9a) in Appendix 1**

– joint width from **0** to **60 mm**

– minimum floor thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – H – X – F – W 0 to 60 *)

4.2.1.9. Linear joint seal **Type I see Fig. 11a) and 11b) in Appendix 1**

– joint width from **0** to **100 mm**

– minimum floor thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r

	120 120													

Resistance to fire class: EI 120 – H – X – F – W 0 to 100 *)

4.2.1.10. Linear joint seal **Type T see Fig. 12a) and 12b) in Appendix 1**

– joint width from **0** to **40 mm**

– minimum floor thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120 120													

Resistance to fire class: EI 120 – H – X – F – W 0 to 40 *)

4.2.1.11. Linear joint seal **Type W see Fig. 13a) in Appendix 1**

– joint width from **0** to **30 mm**

– minimum floor thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	90 90													

Resistance to fire class: EI 90 – H – X – F – W 0 to 30 *)

4.2.1.12. Linear joint seal **Type X see Fig. 13a) in Appendix 1**

– joint width from **0** to **20 mm**

– minimum floor thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120 120													

Resistance to fire class: EI 120 – H – X – F – W 0 to 20 *)

4.2.1.13. Linear joint seal **Type Z see Fig. 14a) in Appendix 1**

– joint width from **0** to **30 mm**

– minimum floor thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	90												

Resistance to fire class: EI 90/E120 – H – X – F – W 0 to 30 *)

4.2.2.1. Linear joint seal **Type E' see Fig. 6a) and 6b) in Appendix 1**

– joint width from **0** to **30 mm**

– minimum floor thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	90	90												

Resistance to fire class: EI 90 – H – X – F – W 0 to 30 *)

4.2.2.2. Linear joint seal **Type E'' see Fig. 6a) and 6b) in Appendix 1**

– joint width from **0** to **40 mm**

– minimum floor thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	60	60												

Resistance to fire class: EI 60 – H – X – F – W 0 to 40 *)

4.2.2.3. Linear joint seal **Type H' see Fig. 10 in Appendix 1**

– joint width from **0** to **40 mm**

– minimum floor thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r

	120	120												

Resistance to fire class: EI 120 – H – X – F – W 0 to 40 *)

4.2.2.4. Linear joint seal **Type H" see Fig. 10 in Appendix 1**

– joint width from **0** to **60 mm**

– minimum floor thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – H – X – F – W 0 to 60 *)

4.2.3.1. Linear joint seal **Type A see Fig. 1b) in Appendix 1**

– joint width from **0** to **30 mm**

– minimum wall thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – T – X – F – W 0 to 30 *)

4.2.3.2. Linear joint seal **Type B see Fig. 2c) and 2d) in Appendix 1**

– joint width from **0** to **20 mm**

– minimum wall thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – T – X – F – W 0 to 20 *)

4.2.3.3. Linear joint seal **Type C see Fig. 3c) and 3d) in Appendix 1**

– joint width from **0** to **25 mm**

– minimum wall thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – T – X – F – W 0 to 25 *)

4.2.3.4. Linear joint seal **Type D see Fig. 4b) in Appendix 1**

– joint width from **0** to **50 mm**

– minimum wall thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – T – X – F – W 0 to 50 *)

4.2.3.5. Linear joint seal **Type E see Fig. 5c) and 5d) in Appendix 1**

– joint width from **0** to **40 mm**

– minimum wall thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – T – X – F – W 0 to 40 *)

4.2.3.6. Linear joint seal **Type F see Fig. 7c) and 7d) in Appendix 1**

– joint width from **0** to **30 mm**

– minimum wall thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – T – X – F – W 0 to 30 *)

4.2.3.7. Linear joint seal **Type G see Fig. 8c) and 8d) in Appendix 1**

– joint width from **0** to **20 mm**

– minimum wall thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – T – X – F – W 0 to 20 *)

4.2.3.8. Linear joint seal **Type H see Fig. 9b) in Appendix 1**

– joint width from **0** to **60 mm**

– minimum wall thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – T – X – F – W 0 to 60 *)

4.2.3.9. Linear joint seal **Type I see Fig. 11b) in Appendix 1**

– joint width from **0** to **100 mm**

– minimum wall thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – T – X – F – W 0 to 100 *)

4.2.3.10. Linear joint seal **Type T see Fig. 12c) and 12d) in Appendix 1**

– joint width from **0** to **40 mm**

– minimum wall thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – T – X – F – W 0 to 40 *)

4.2.3.11. Linear joint seal **Type W see Fig. 13b) in Appendix 1**

– joint width from **0** to **30 mm**

– minimum wall thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	90	90												

Resistance to fire class: EI 90 – T – X – F – W 0 to 30 *)

4.2.3.12. Linear joint seal **Type X see Fig. 13b) in Appendix 1**

– joint width from **0** to **20 mm**

– minimum wall thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	120												

Resistance to fire class: EI 120 – T – X – F – W 0 to 20 *)

4.2.3.13. Linear joint seal **Type Z see Fig. 14b) in Appendix 1**

– joint width from **0** to **30 mm**

– minimum wall thickness – **15 cm**

R	E	I	W		t	t	-	M	C	S	IncSlow	sn	ef	r
	120	90												

Resistance to fire class: EI 90/E 120 – T – X – F – W 0 to 30 *)

4.3. Field of application

This classification is valid for the following end use applications:

4.3.1. Permitted orientation in accordance with EN 1366-4:2006:

– **A** – horizontal linear joint seals in a horizontal supporting construction – joints seals classified in 4.2.1.1 - 4.2.1.13,

– **D** – horizontal wall joint abutting a floor, ceiling or roof – joints seals classified in 4.2.2.1 - 4.2.2.4,

– **E** – horizontal floor joint abutting a wall – joints seals classified in 4.2.3.1 - 4.2.3.13,

4.3.2. Application to supporting constructions elements in accordance with 13.2 of EN 1366-4:2006 made of aerated concrete blocks, concrete, concrete works and masonry with full filled mortar density at least 600 kg/m^3 and thickness given in 4.2.

4.3.3. Application to straight linear joints with parallel surfaces of elements sealed edges in accordance with Fig. 3.

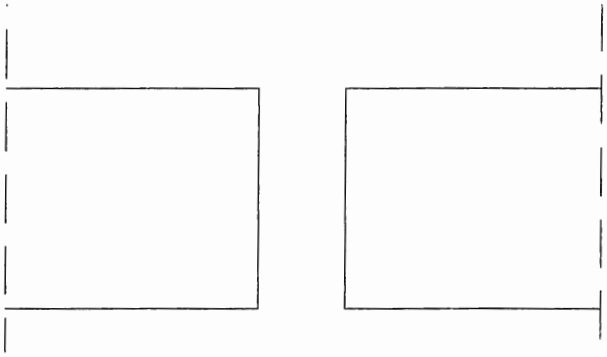

Fig. 3.

5. Limitations

This classification document does not represent type approval or certification of the product.

SIGNED

Marek Łukomski M.Sc. Civil Eng.

APPROVED

Head of Fire Research Department

Andrzej Borowy Ph.D.

Appendix No. 1
to the Classification Report No.
NP-02491.2/A/2009/MŁ

Key to the figures No. 1-14

1. SOUDASEAL FR
2. PU BACKING ROD
3. FIRESILICONE FR
4. FIRECRYL FR
5. SOUDAFOAM FR
6. MINERAL WOOL 80

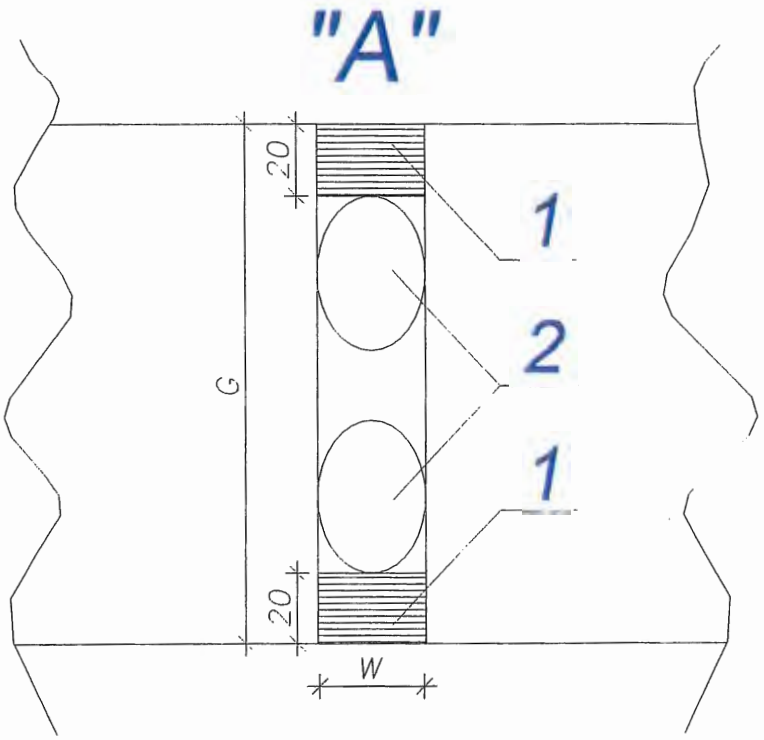

Fig. No 1a). Details of joint seal Type A.

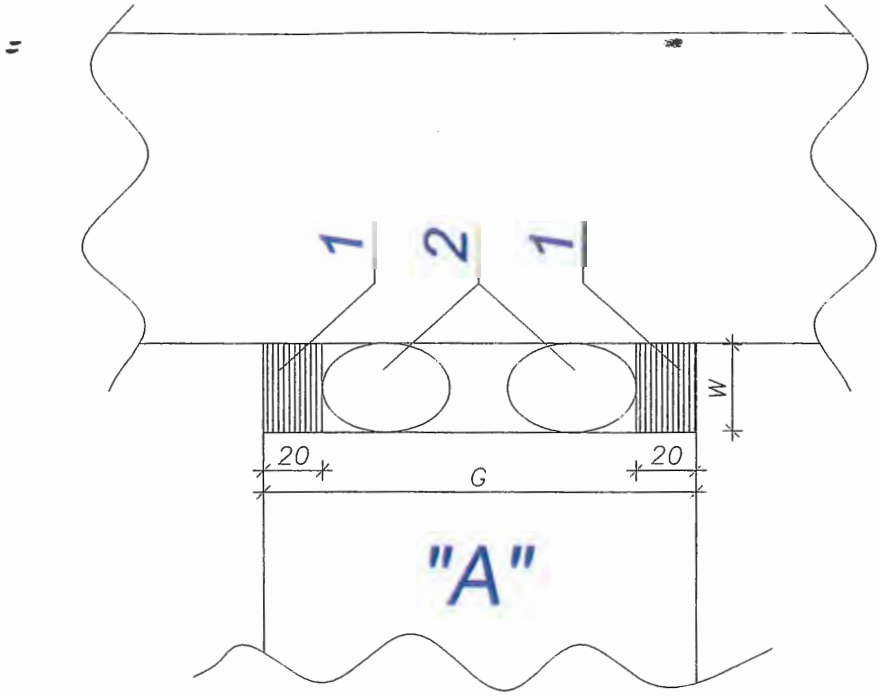

Fig. No 1b). Details of joint seal Type A.

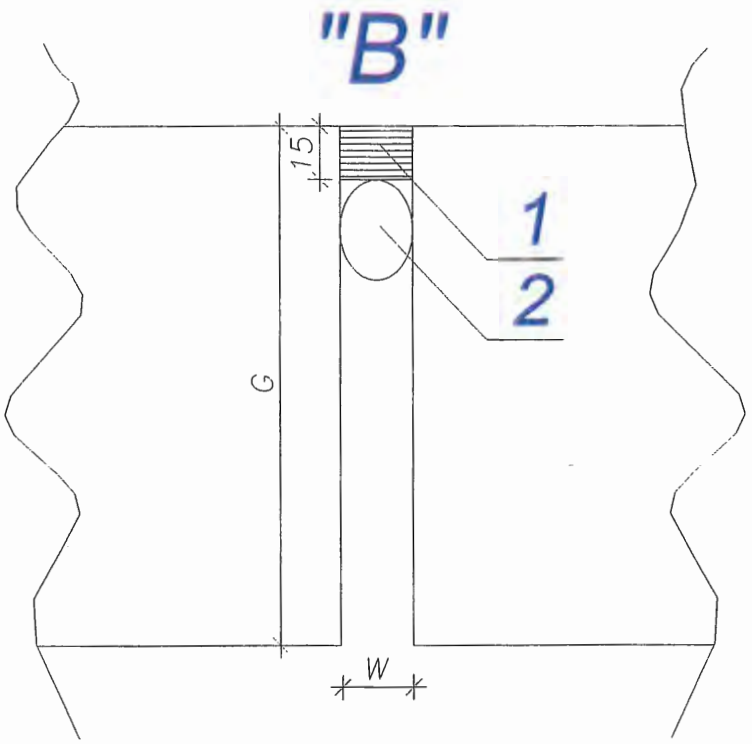

Fig. No 2a). Details of joint seal Type B.

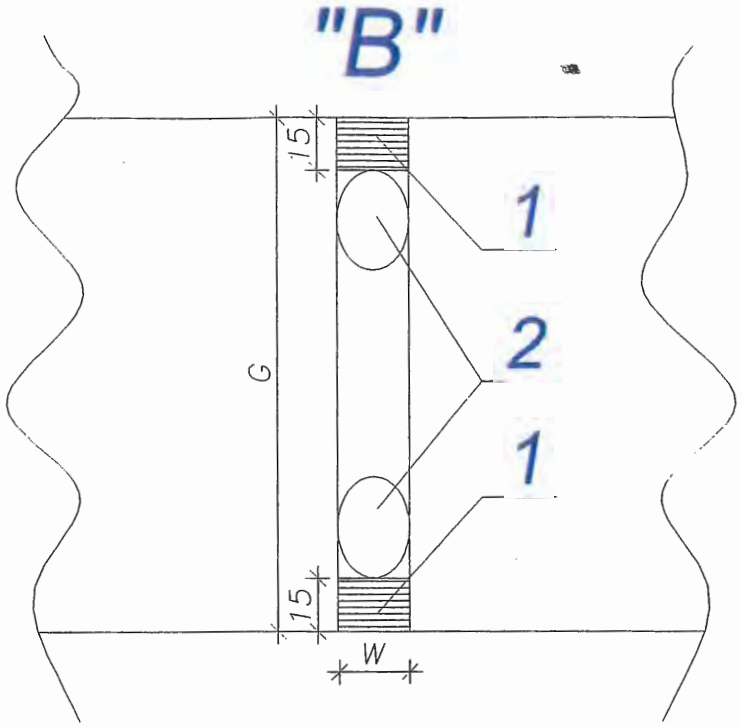

Fig. No 2b). Details of joint seal Type B.

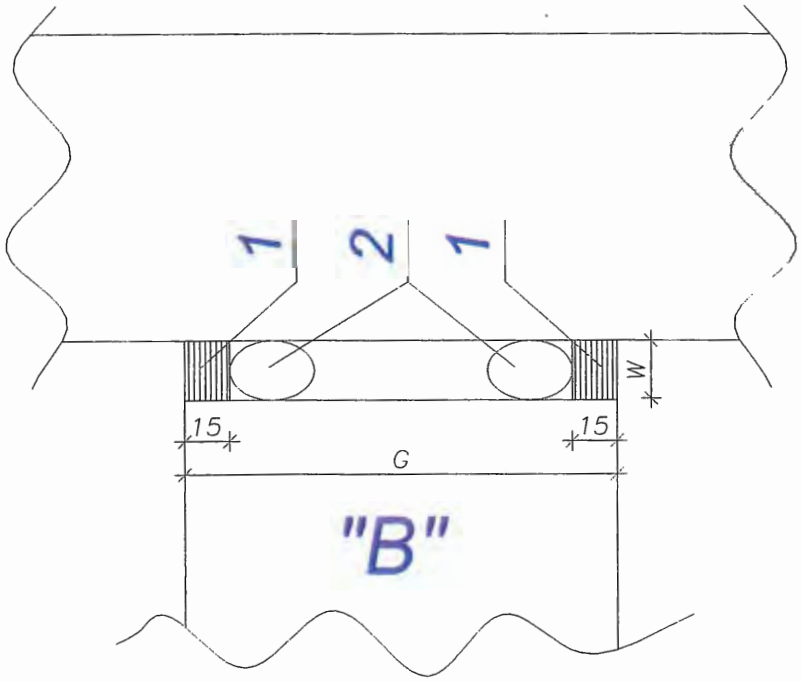

Fig. No 2c). Details of joint seal Type B.

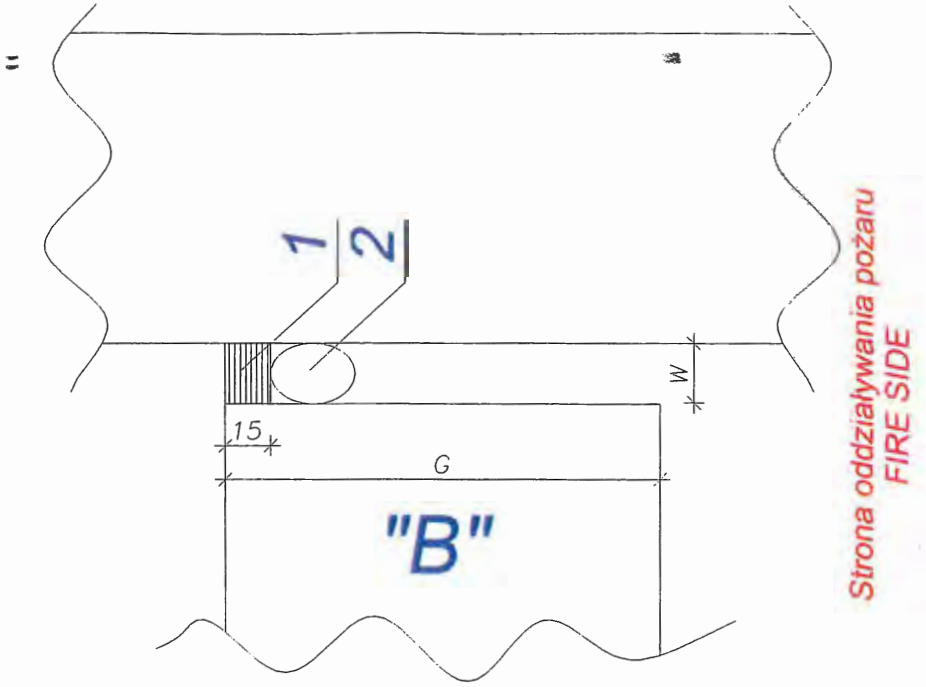

Fig. No 2d). Details of joint seal Type B.

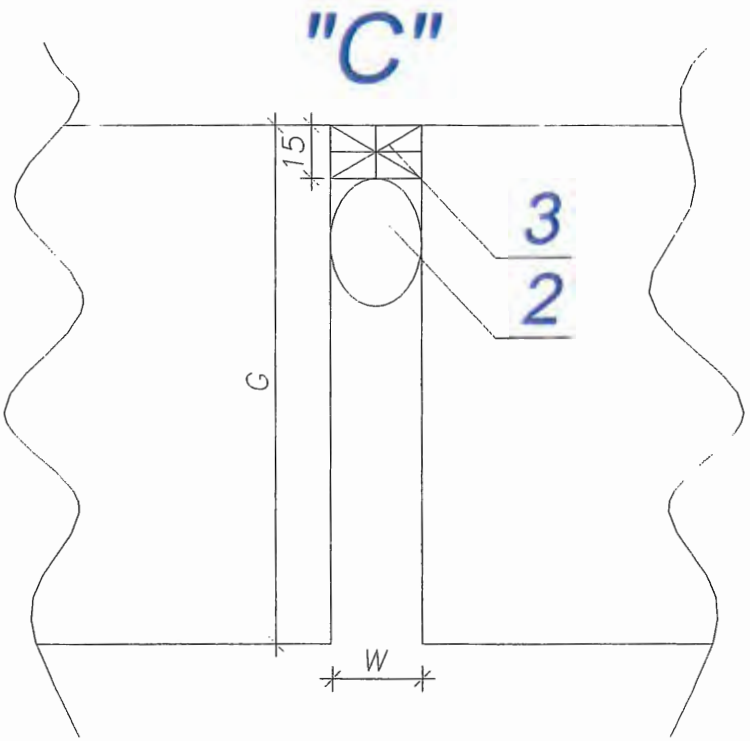

Fig. No 3a). Details of joint seal Type C.

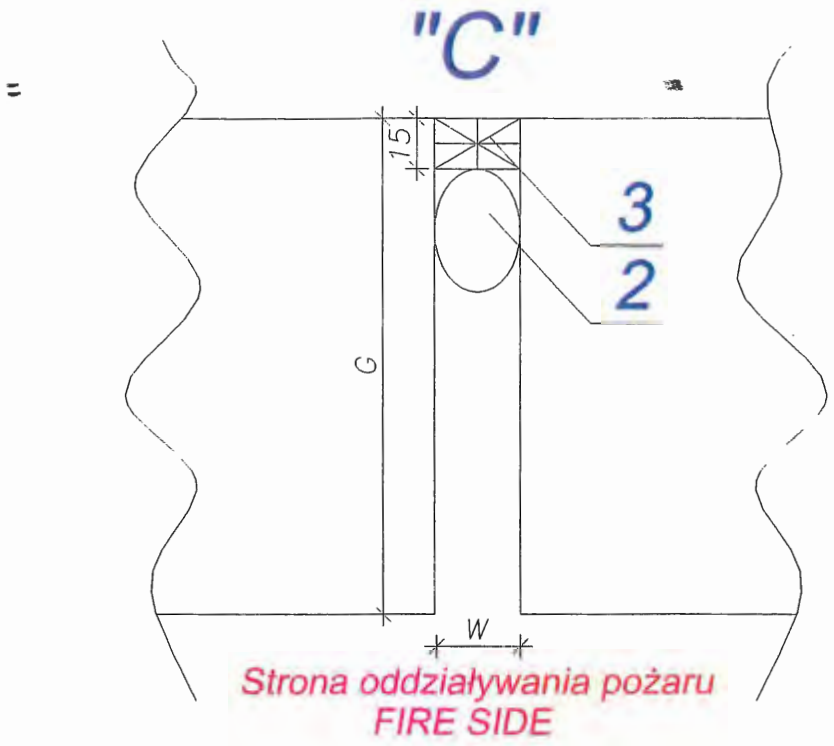

Fig. No 3b). Details of joint seal Type C.

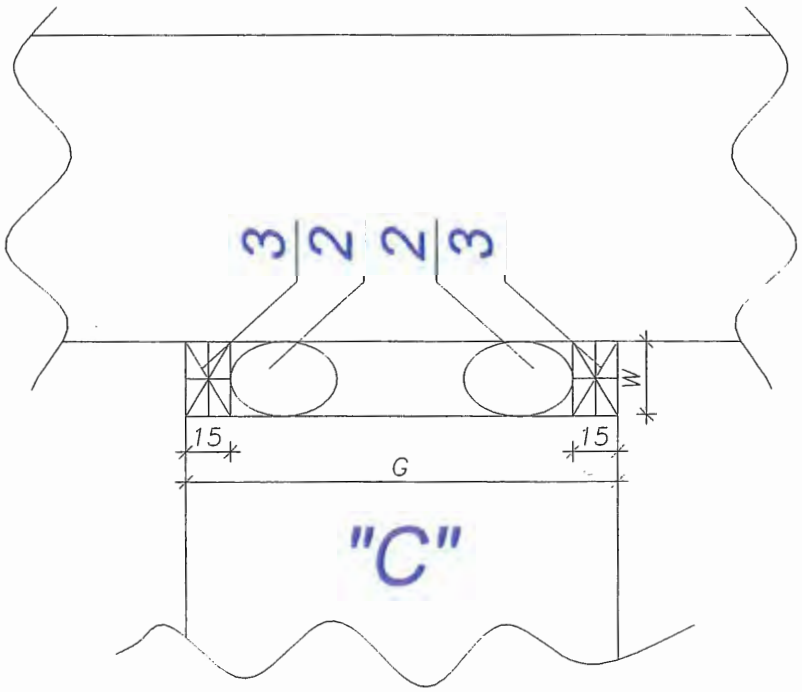

Fig. No 3c). Details of joint seal Type C.

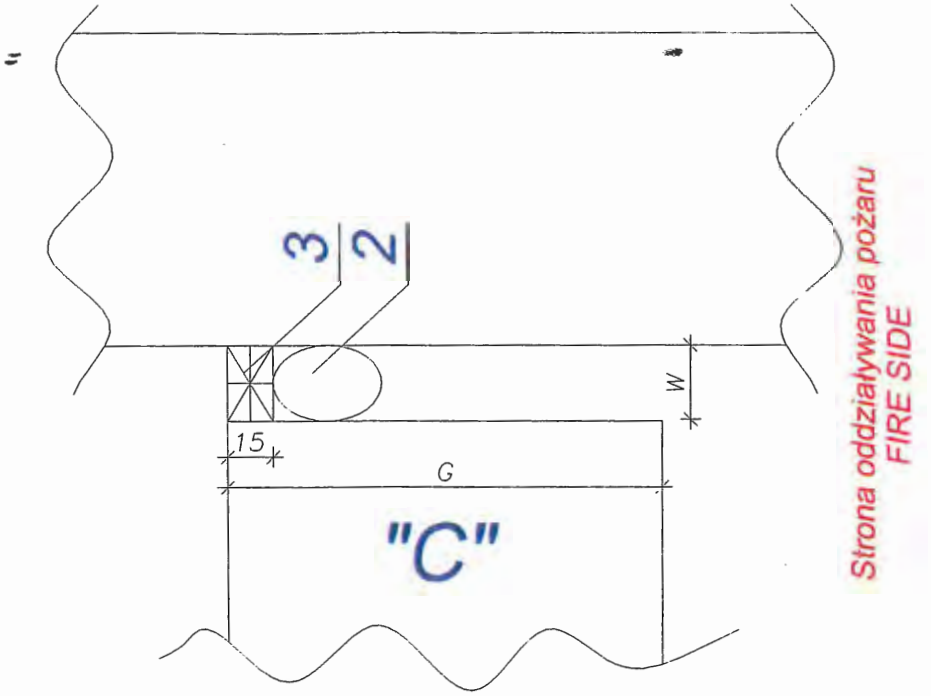

Fig. No 3d). Details of joint seal Type C.

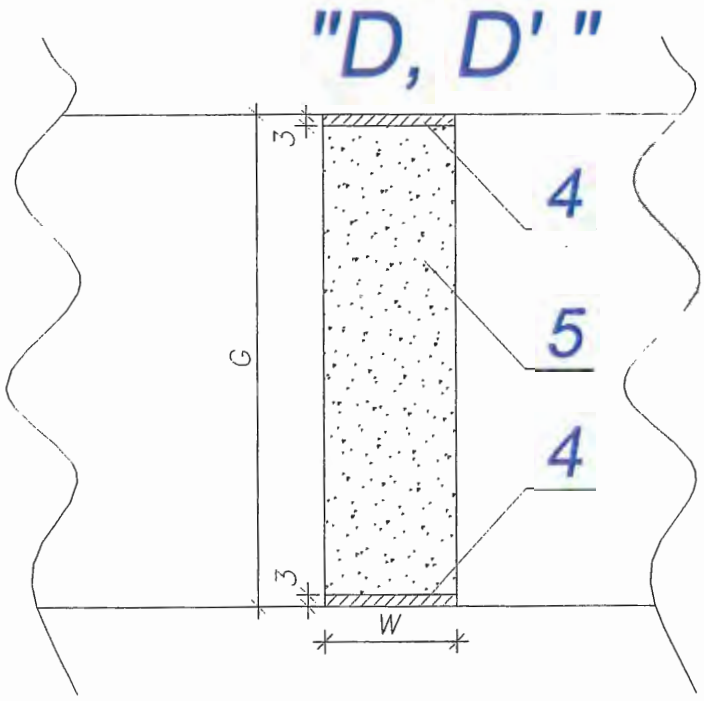

Fig. No 4a). Details of joint seal Type D and D'.

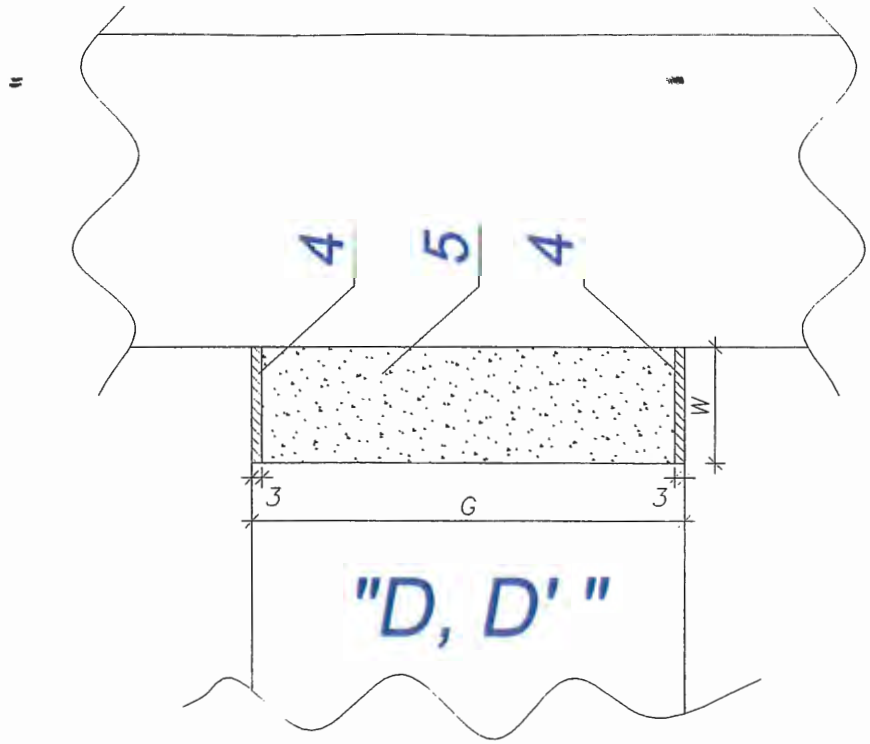

Fig. No 4b). Details of joint seal Type D and D'.

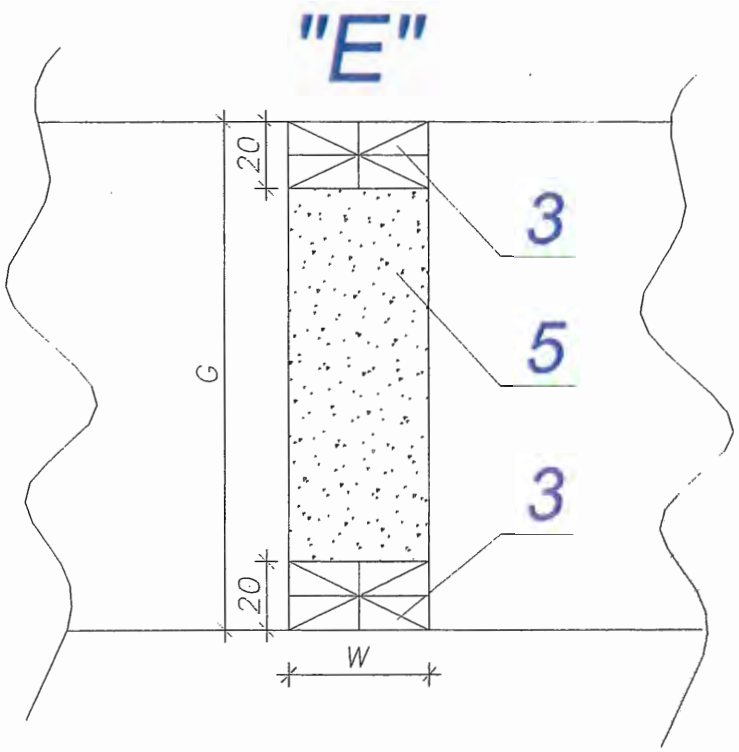

Fig. No 5a). Details of joint seal Type E.

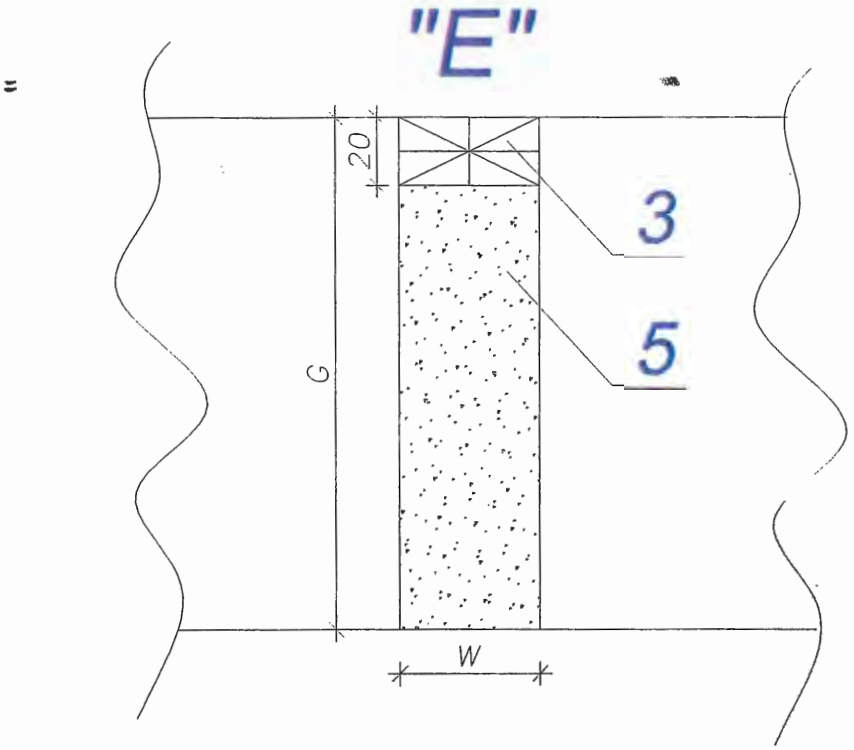

Fig. No 5b). Details of joint seal Type E.

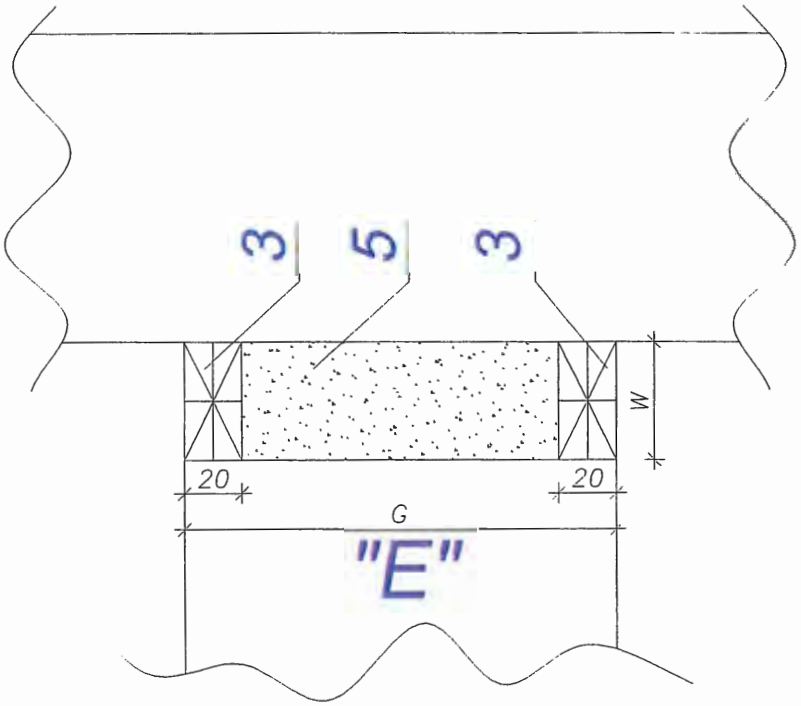

Fig. No 5c). Details of joint seal Type E.

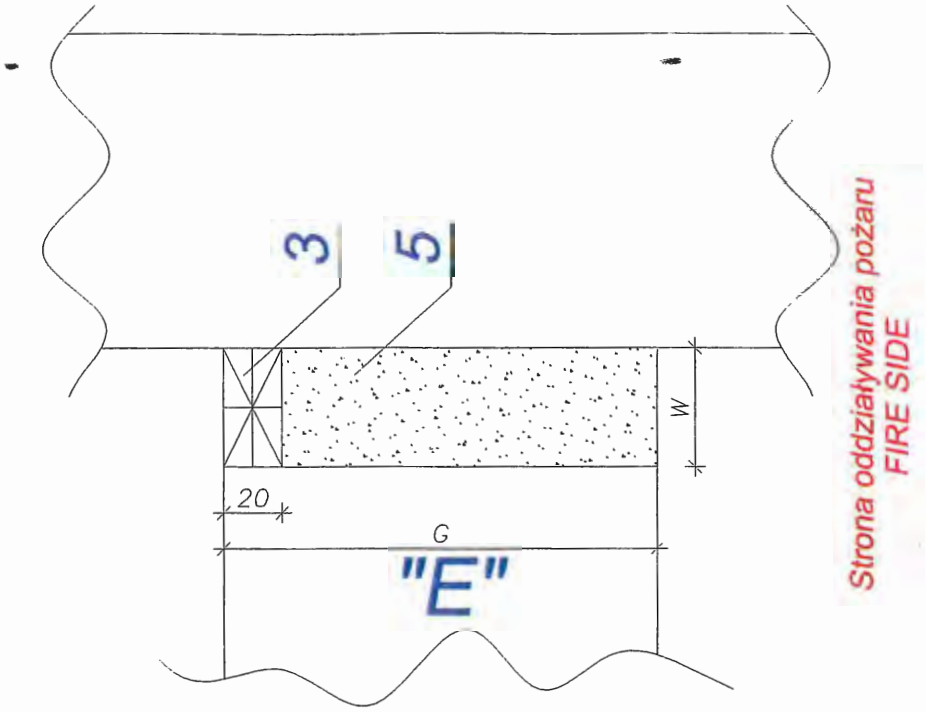

Fig. No 5d). Details of joint seal Type E.

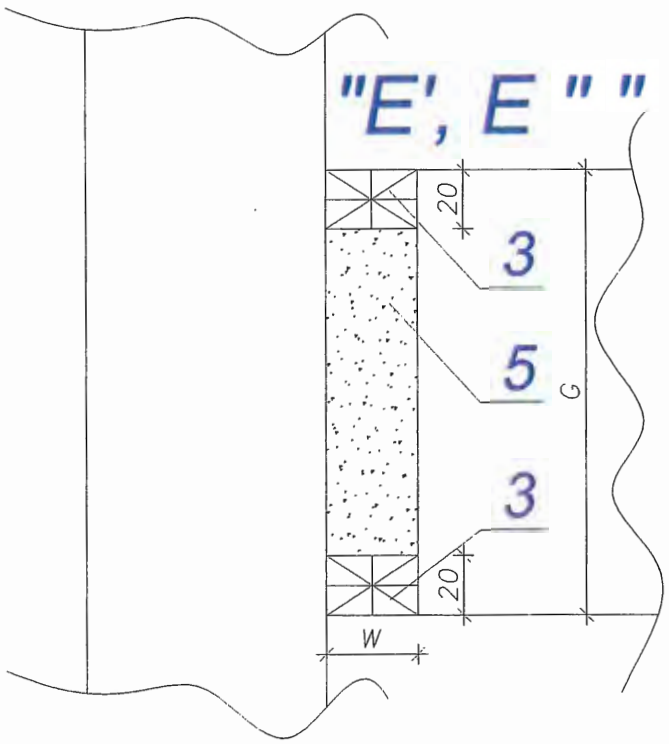

Fig. No 6a). Details of joint seal E' i E".

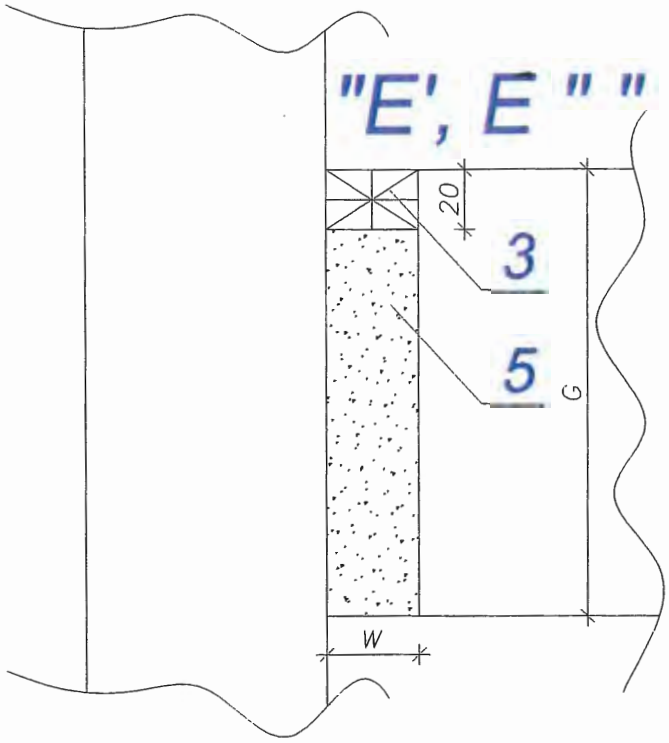

Fig. No 6b). Details of joint seal E' i E".

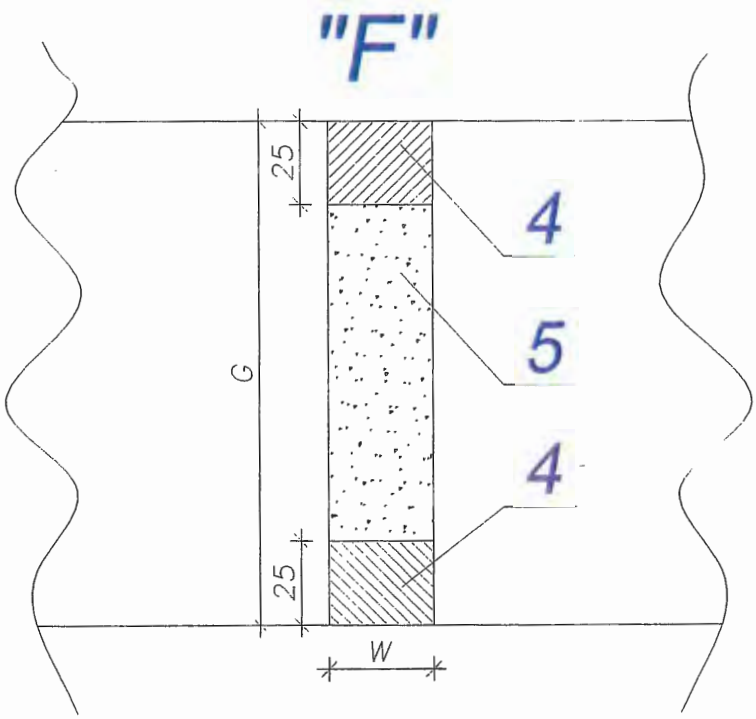

Fig. No 7a). Details of joint seal F.

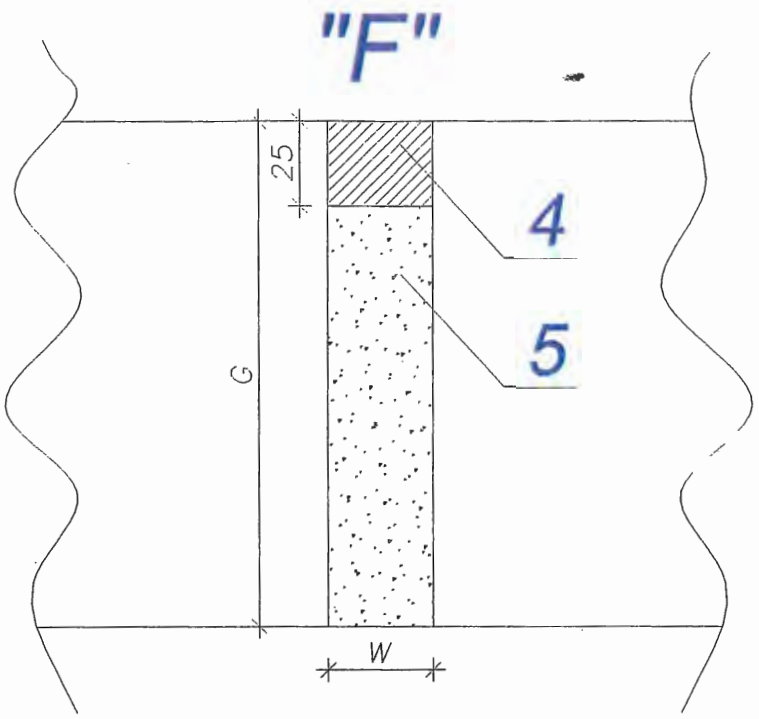

Fig. No 7b). Details of joint seal F.

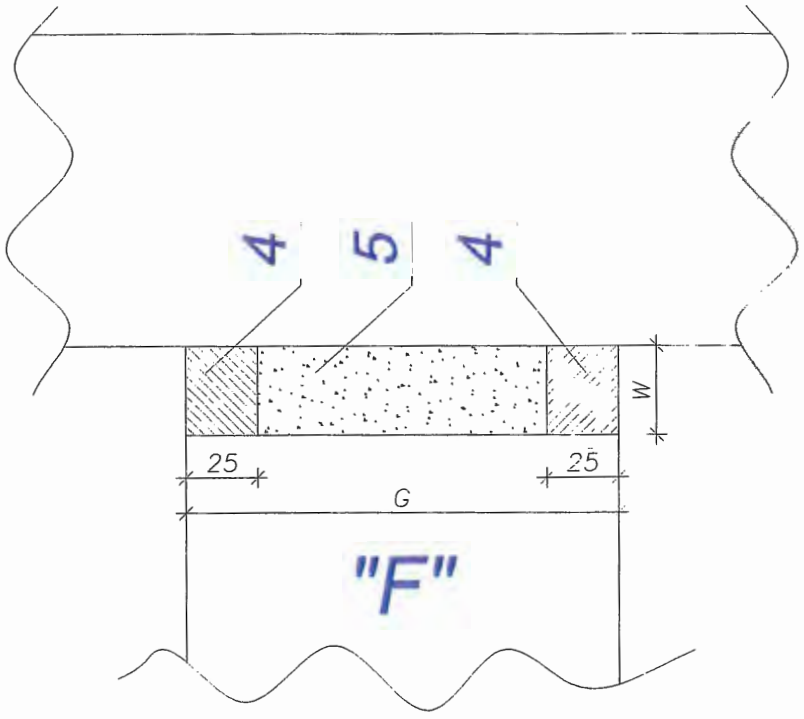

Fig. No 7c). Details of joint seal F.

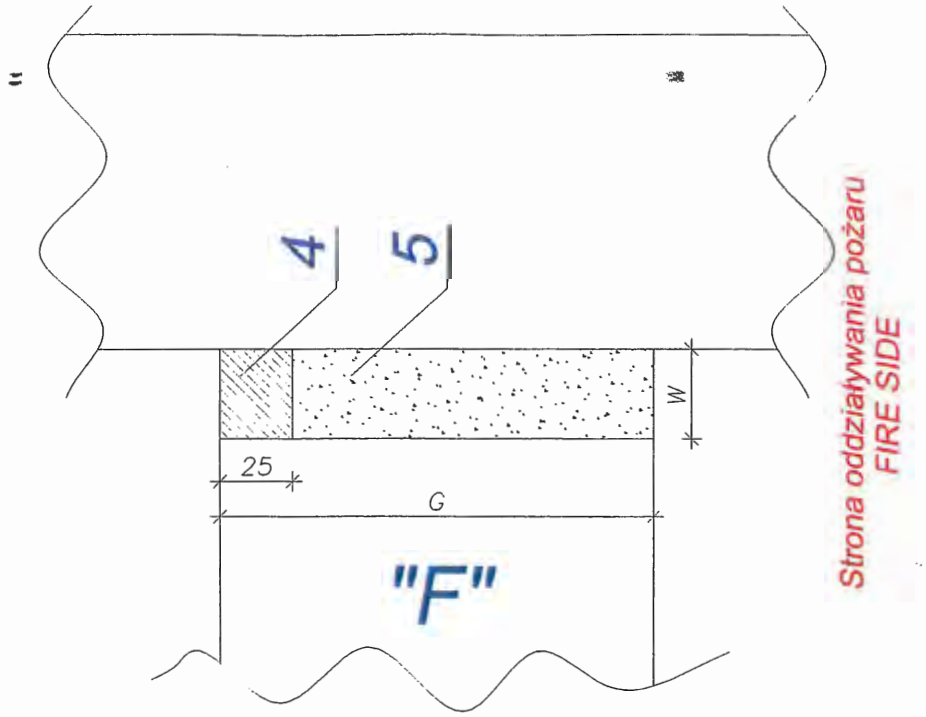

Fig. No 7d). Details of joint seal F.

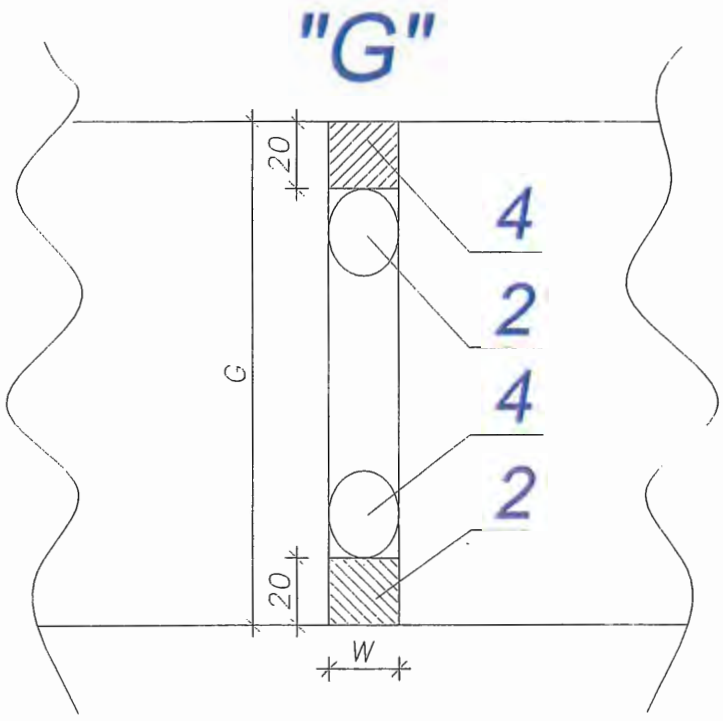

Fig. No 8a). Details of joint seal G.

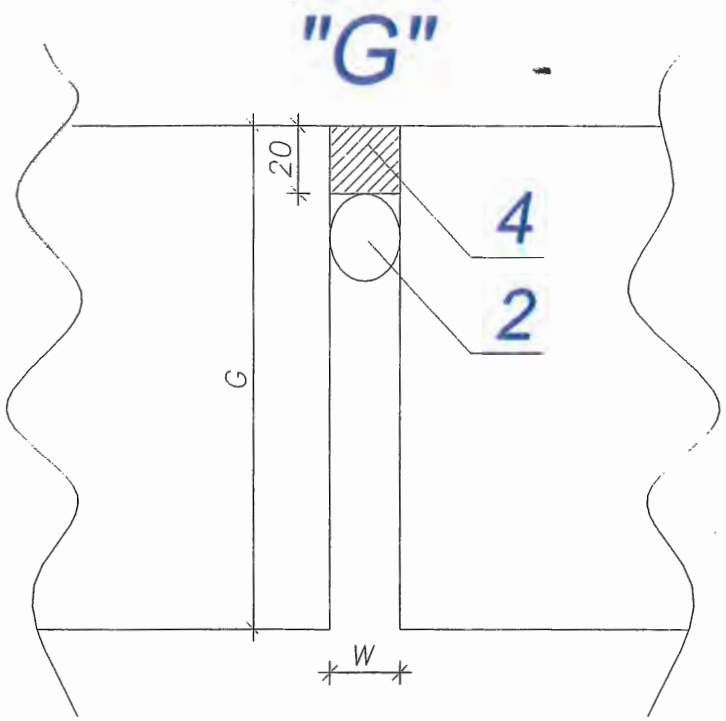

Fig. No 8b). Details of joint seal G.

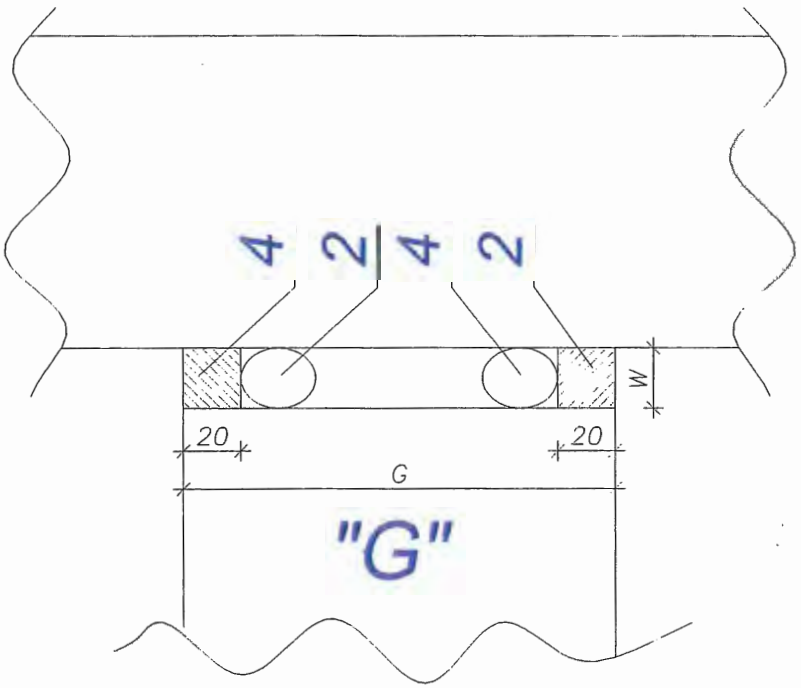

Fig. No 8c). Details of joint seal G.

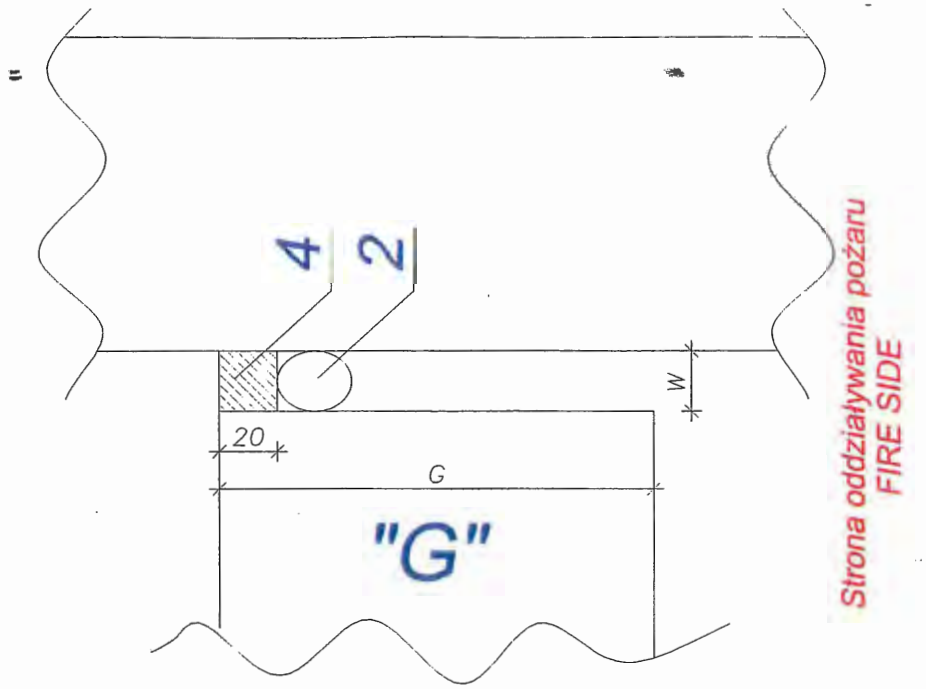

Fig. No 8d). Details of joint seal G.

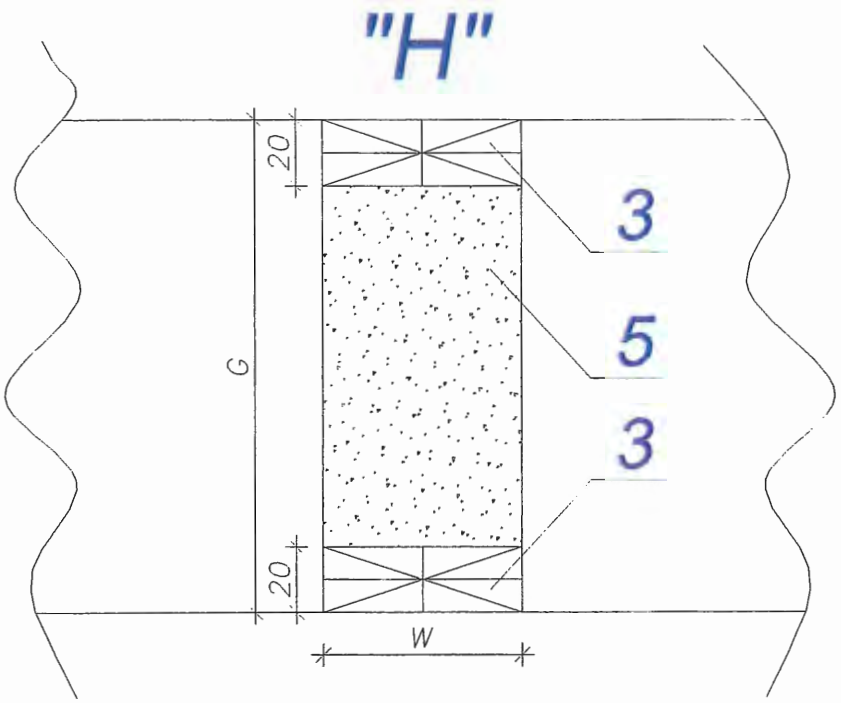

Fig. No 9a). Details of joint seal H.

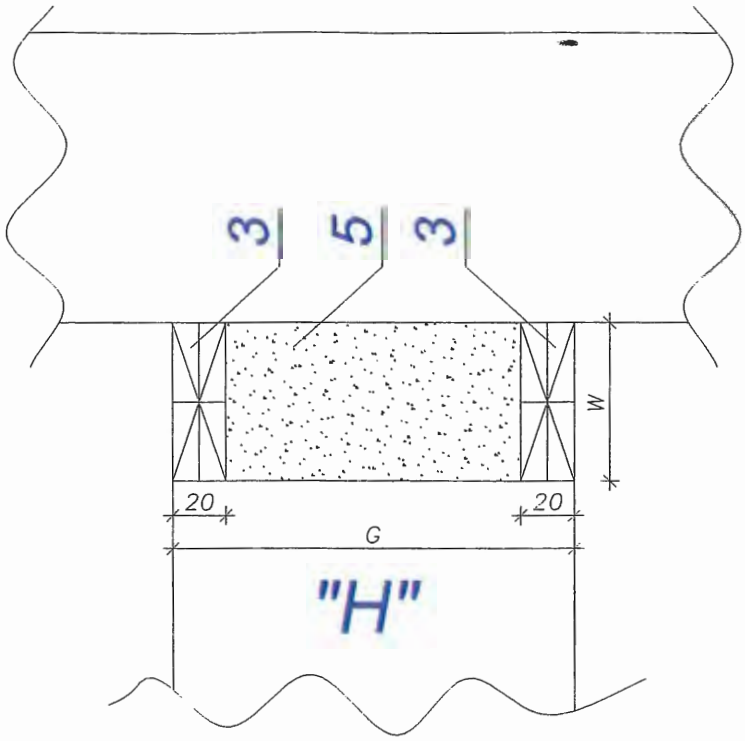

Fig. No 9b). Details of joint seal H.

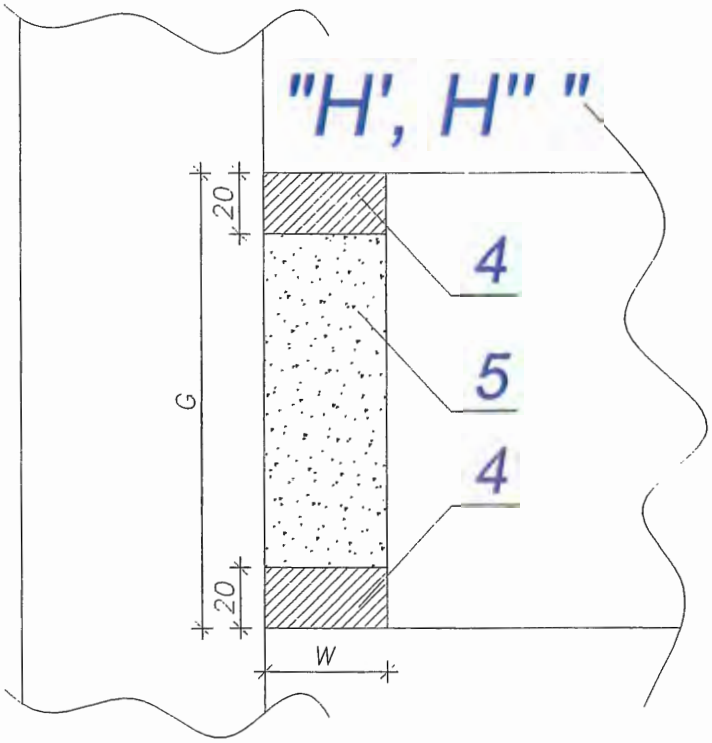

Fig. No 10). Details of joint seal H' i H".

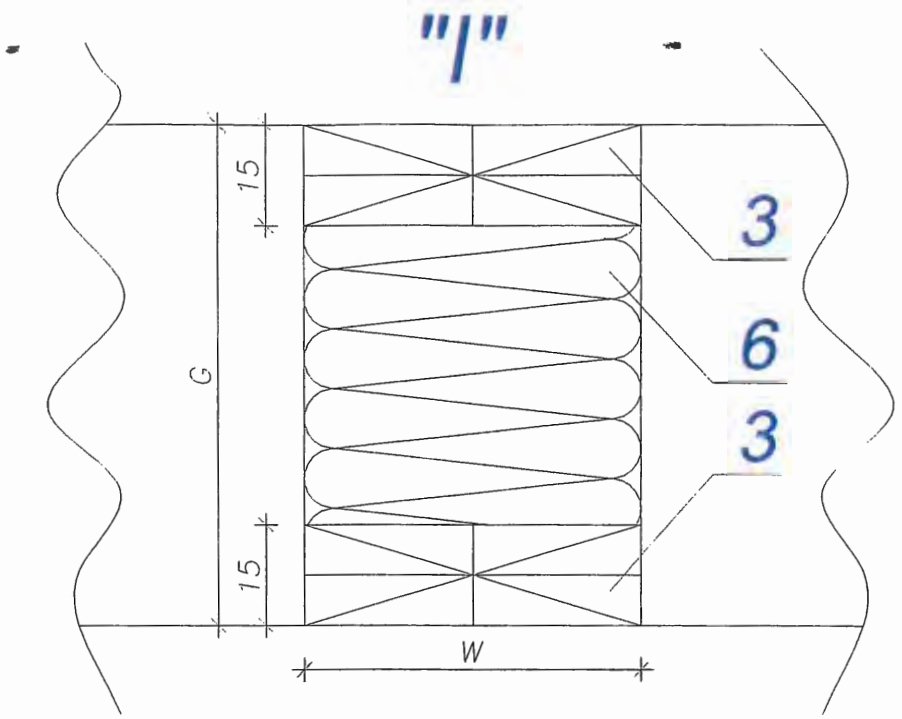

Fig. No 11a). Details of joint seal I.

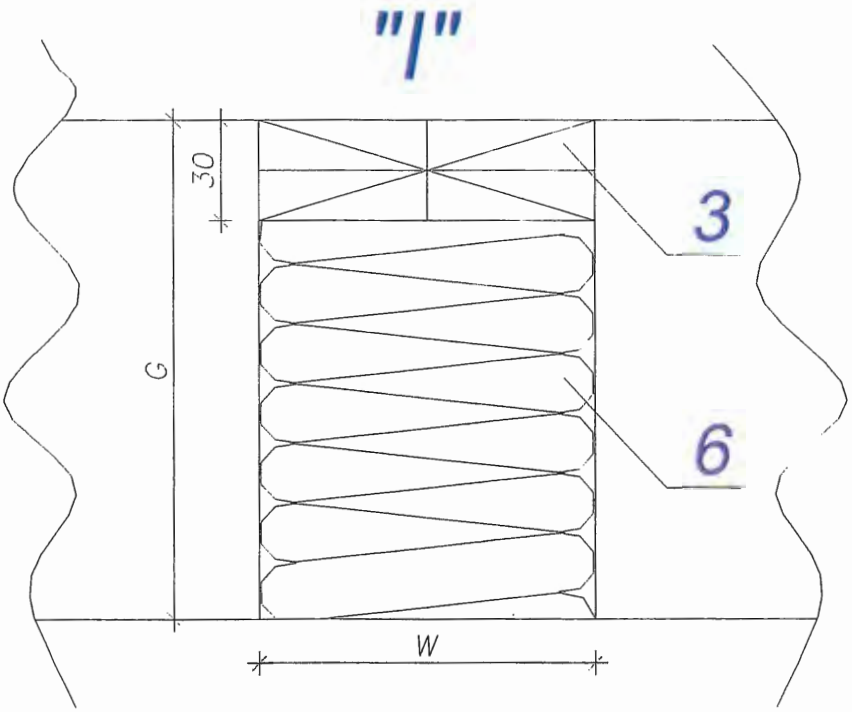

Fig. No 11b). Details of joint seal I.

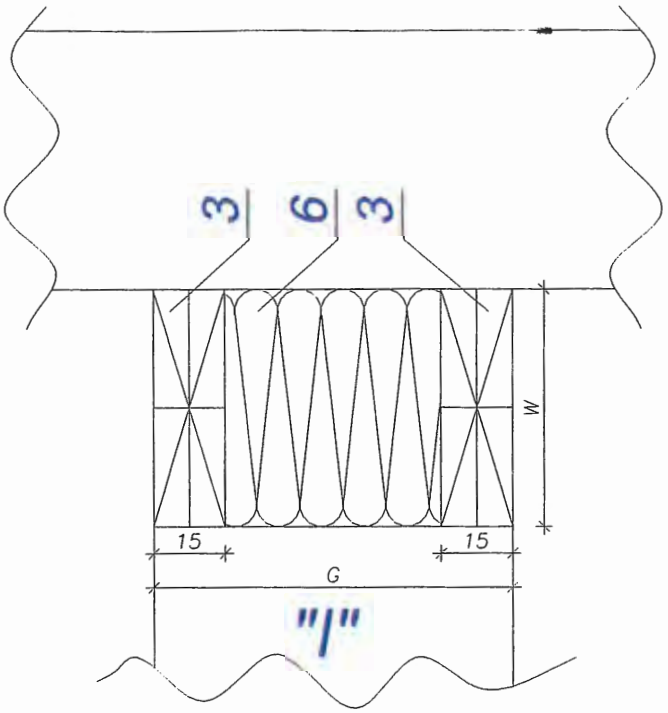

Fig. No 11c). Details of joint seal I.

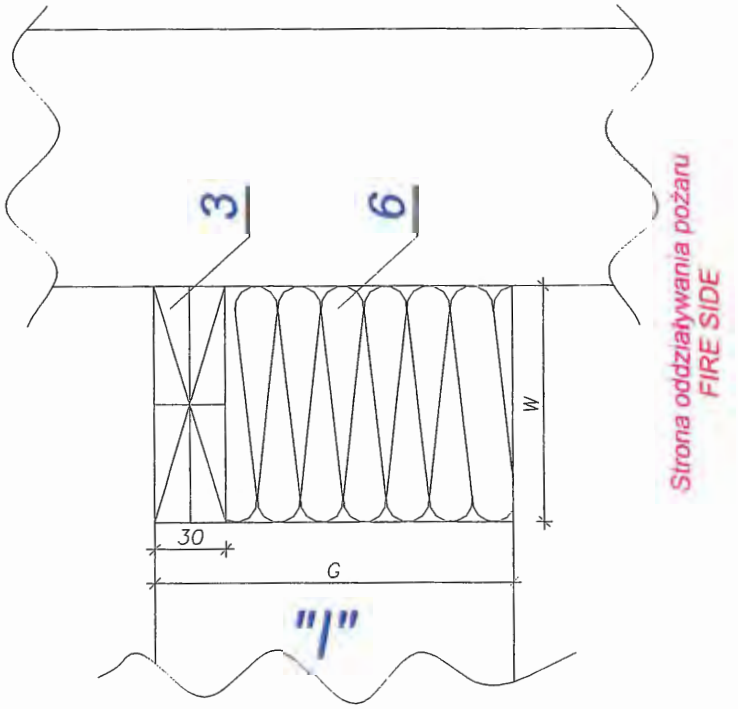

Fig. No 11d). Details of joint seal I.

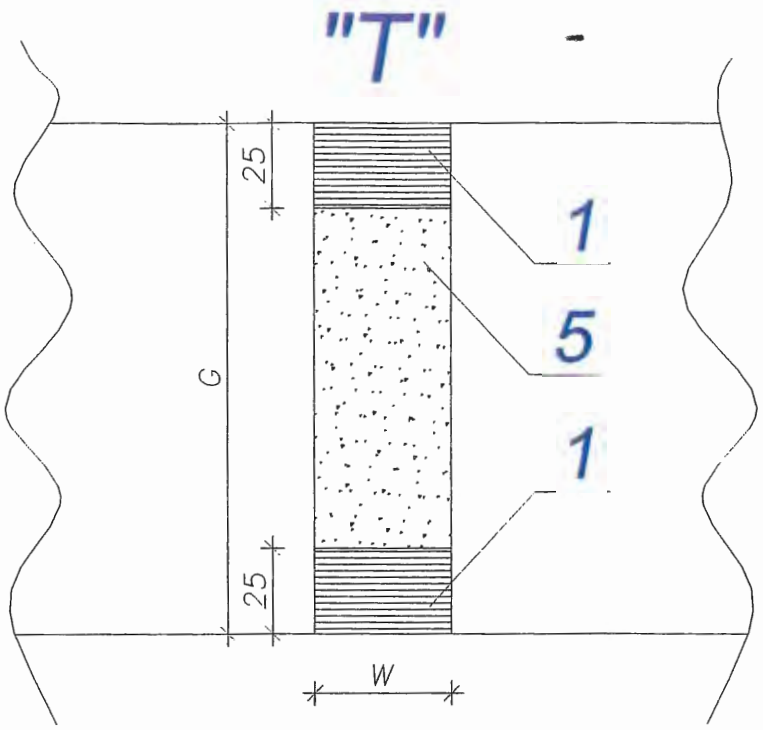

Fig. No 12a). Details of joint seal T.

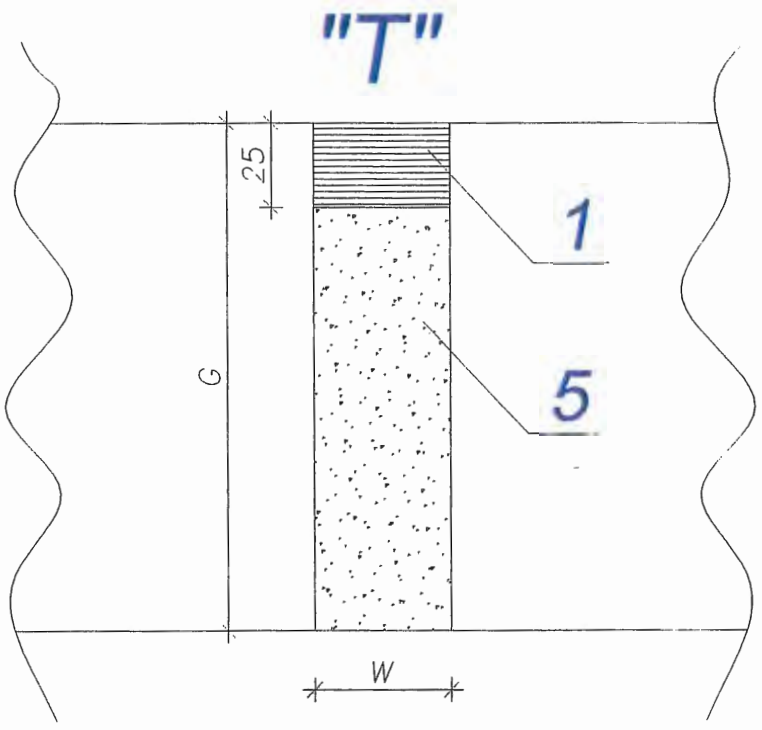

Fig. No 12b). Details of joint seal T.

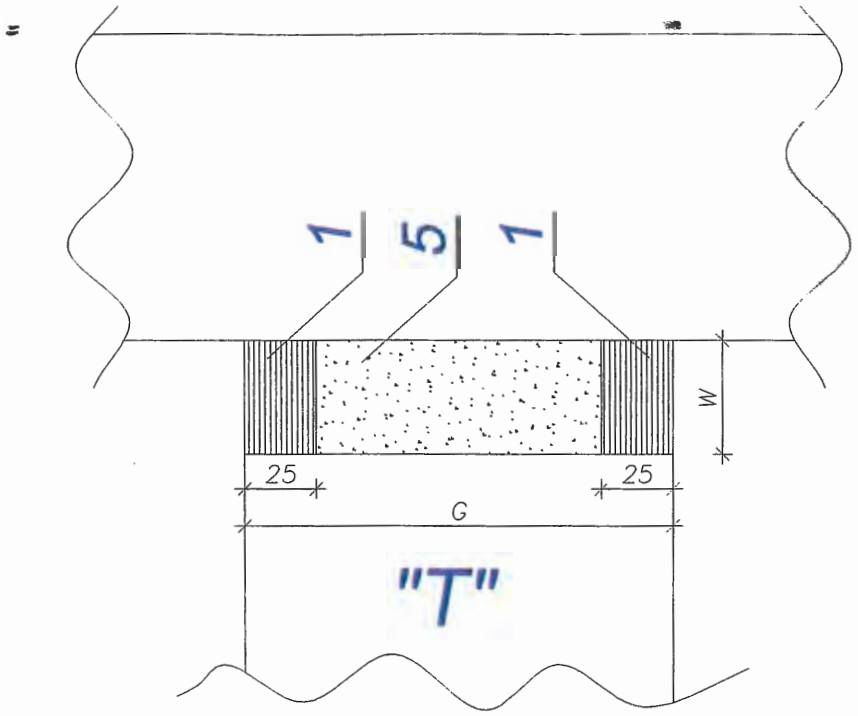

Fig. No 12c). Details of joint seal T.

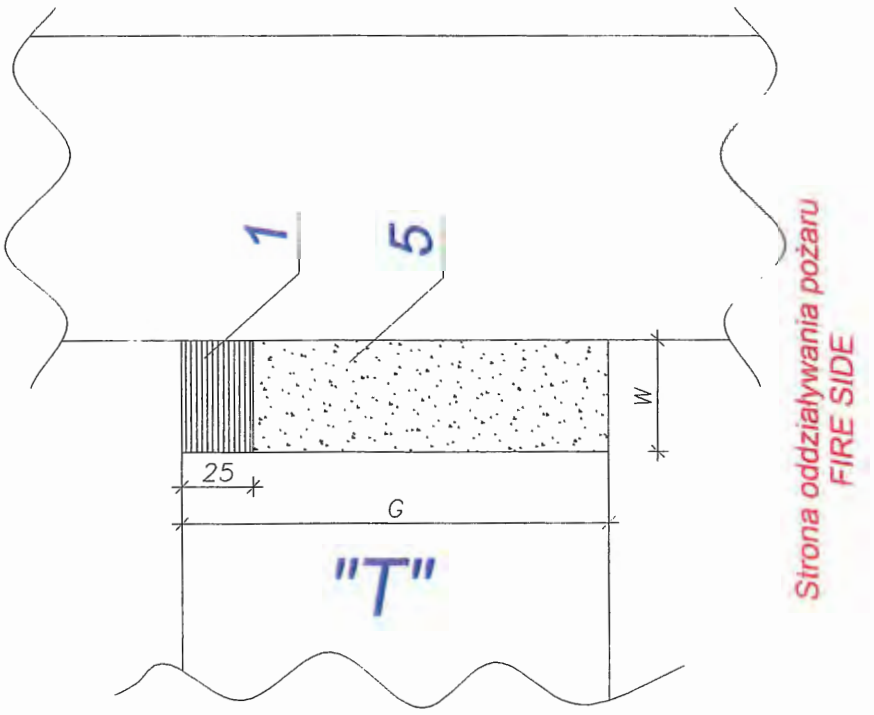

Fig. No 12d). Details of joint seal T.

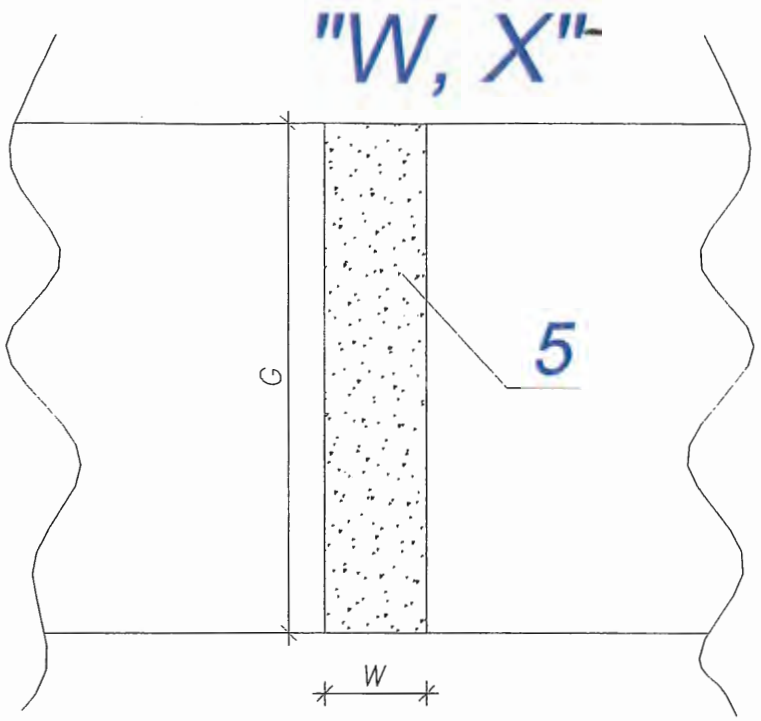

Fig. No 13a). Details of joint seal W i X.

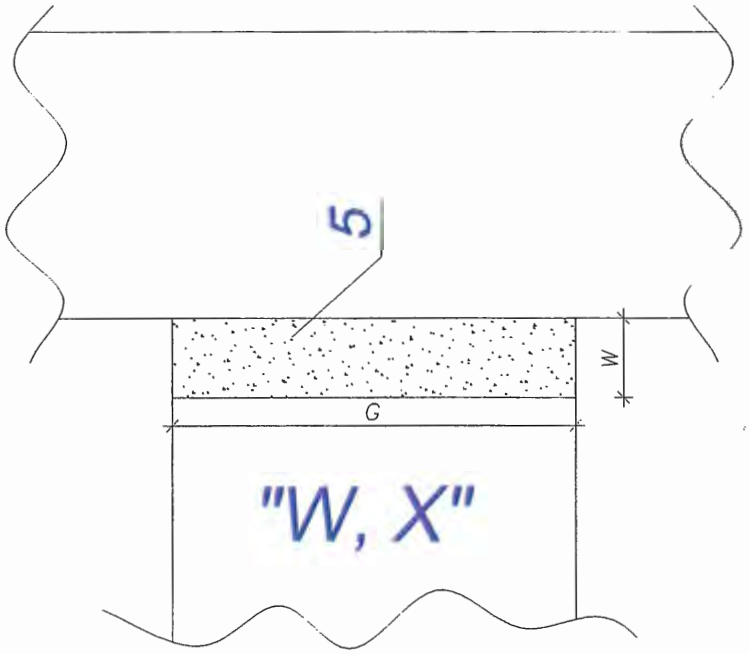

Fig. No 13b). Details of joint seal W i X.

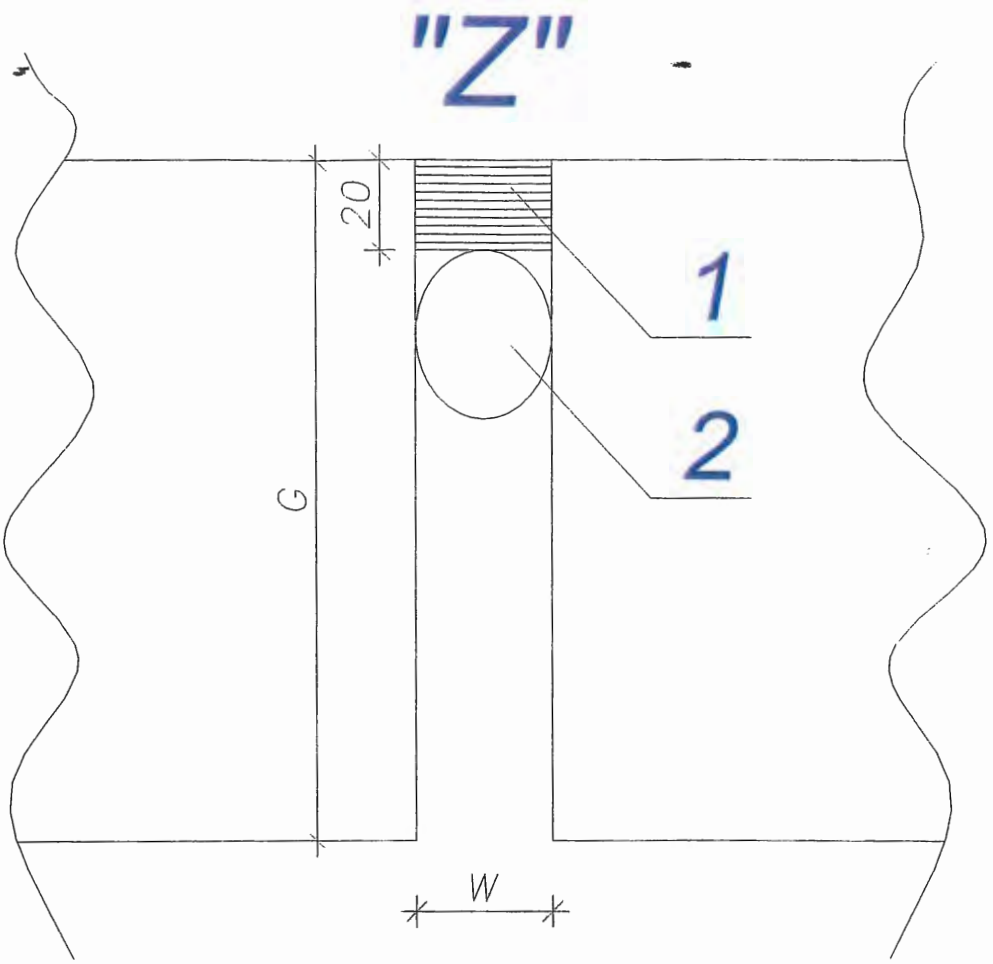

Fig. No 14a). Details of joint seal Z.

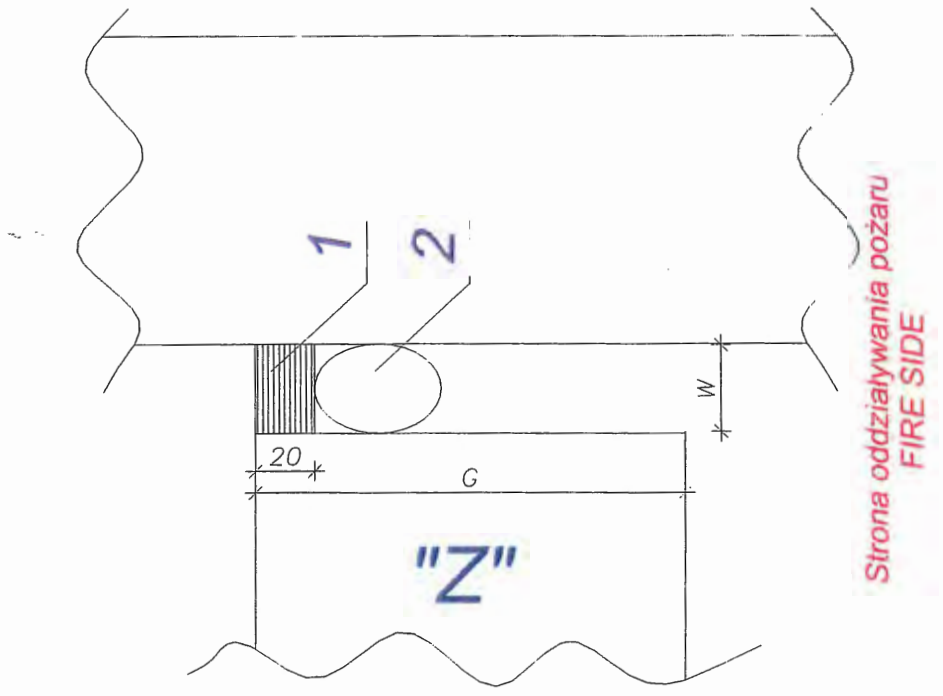

Fig. No 14b). Details of joint seal Z.