Lecture 7

Steel Hall Buildings – Part 6: Connections / Cranes / Loads

Acknowledgement

I express my gratitude to doctor Dawid Mądry for creating this work and for professor Antoni Biegus for making available to me the materials incorporated in his book "Stalowe budynki halowe" (Steel industrial buildings), which were mainly used at drawing this work up

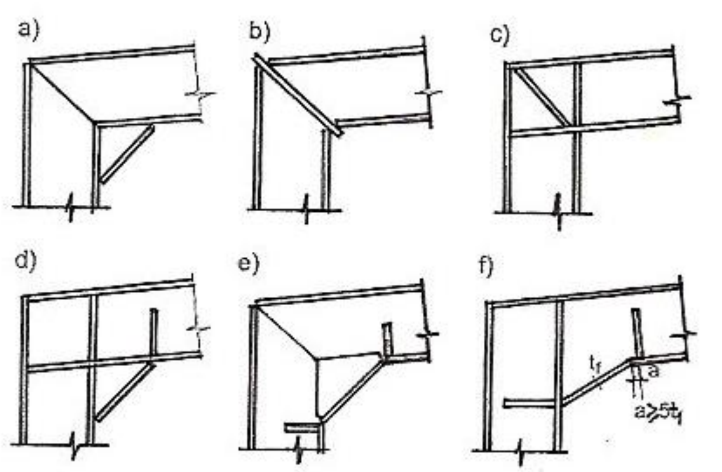


Fig.7.1 Examples of shop welded haunches in small-span frames

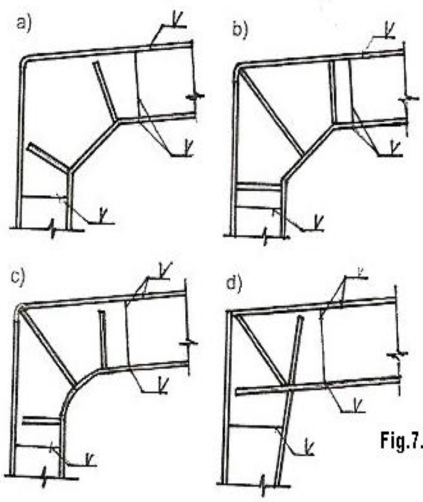


Fig.7.2 Examples of shop welded haunches in medium-span frames

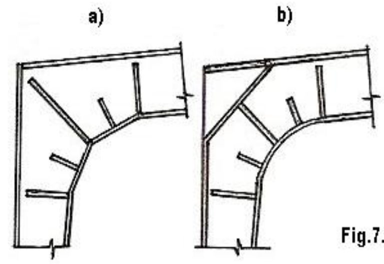


Fig.7.3 Examples of shop welded haunches in long-span frames

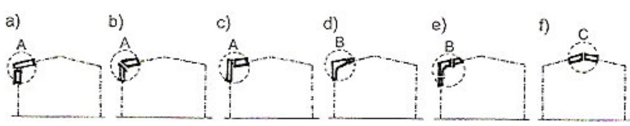


Fig.7.4 Location of column to rafter field connection

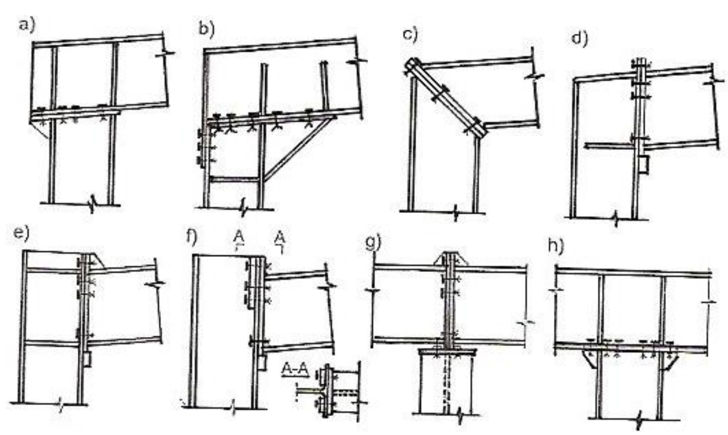
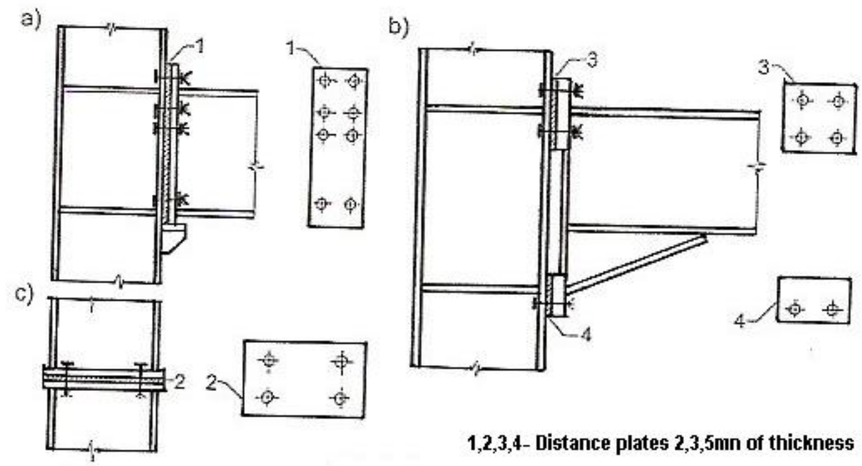


Fig.7.5 Details of bolted field connections



1,2,3,4- Distance plates 2,3,5mn of thickness

Fig.7.6 Examples of field connections with distance plates

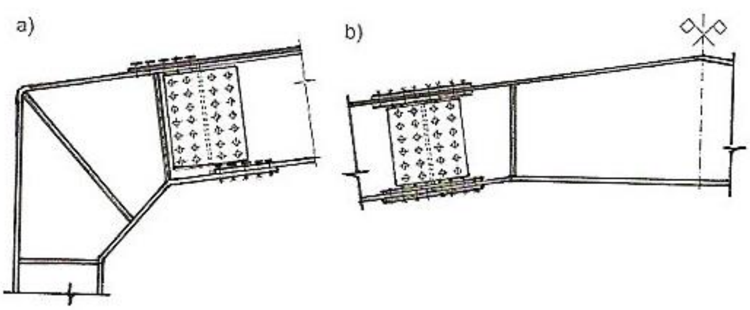


Fig.7.7 Examples of lap field connections of solid elements

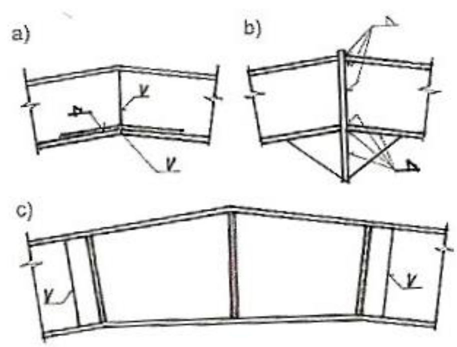


Fig.7.8 Example of ridge shop welded connection

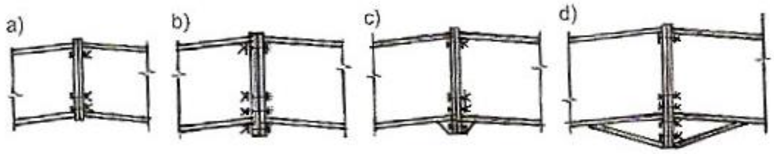


Fig.7.9 Examples of ridge field bolted connections

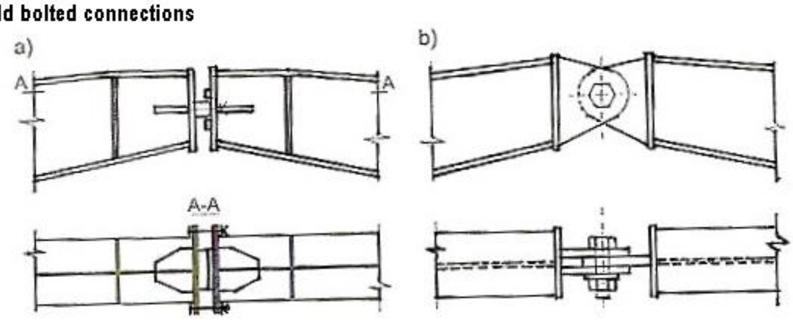


Fig.7.10 Examples of pin, field connections

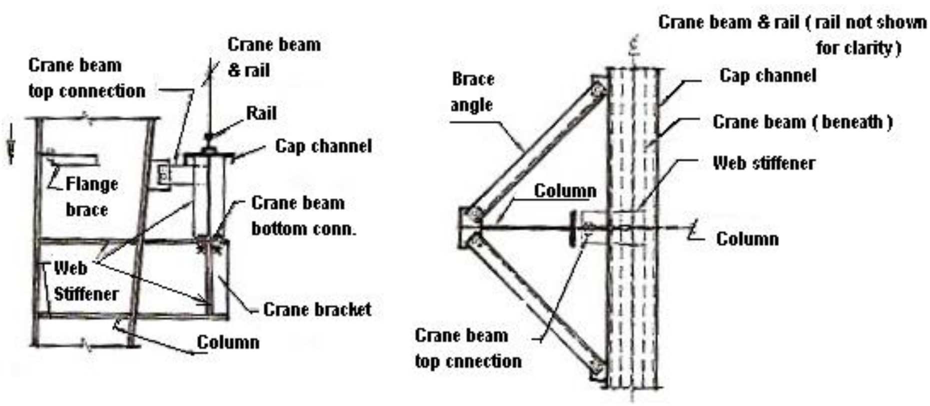


Fig.8.1 Bracket-supported runway beam for top-running crane

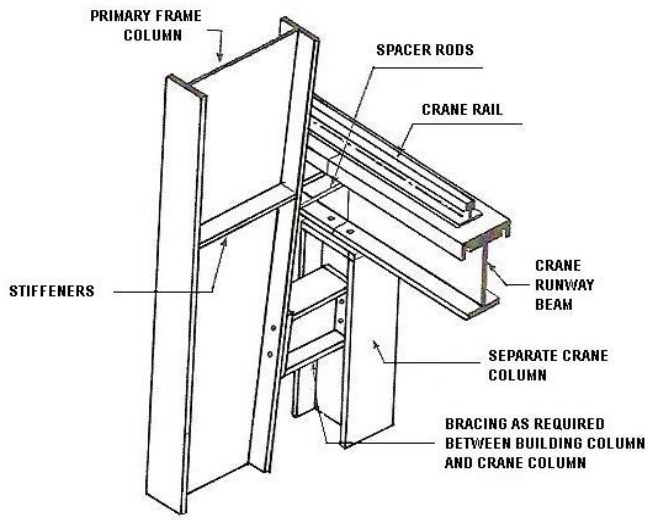


Fig.8.2 Crane runway beam supported by separate column

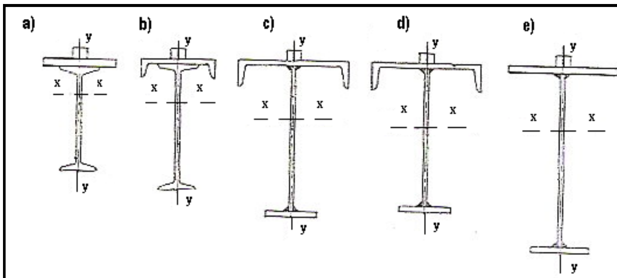


Fig.8.3 Examples of crane runway beam cross-sections

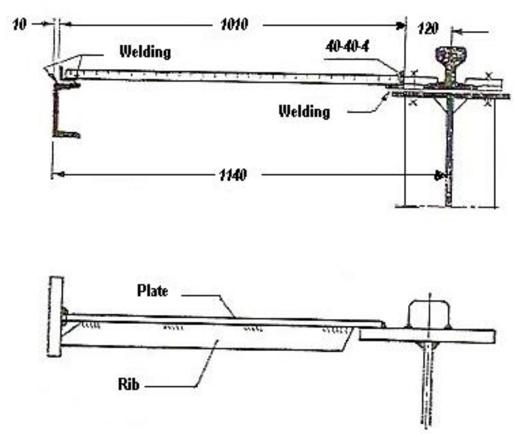


Fig.8.4 Examples of a runway beams braced horizontally by a plate

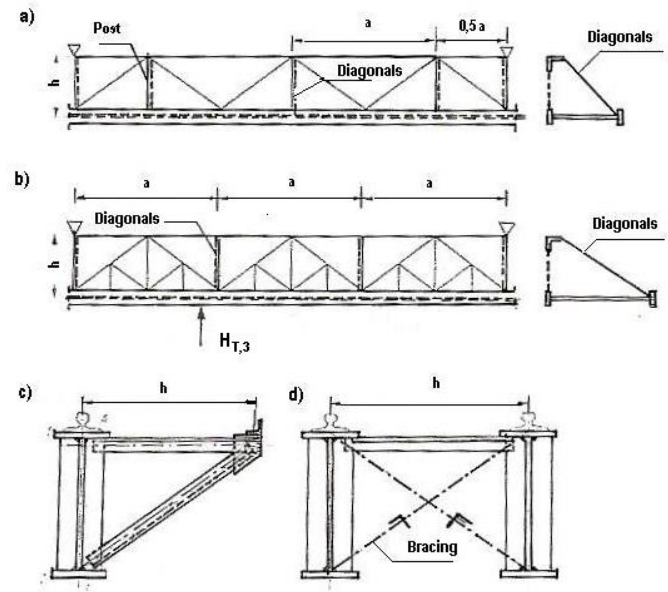


Fig.8.5 Example of a runway beam horizontally braced

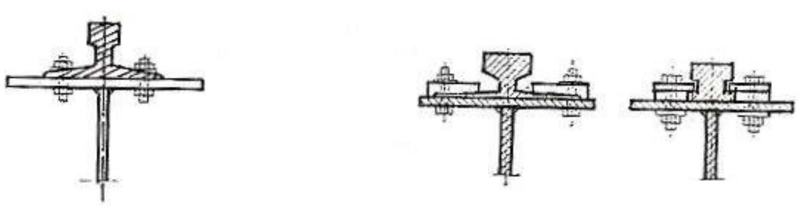


Fig.8.6 Example of rail to beam connection

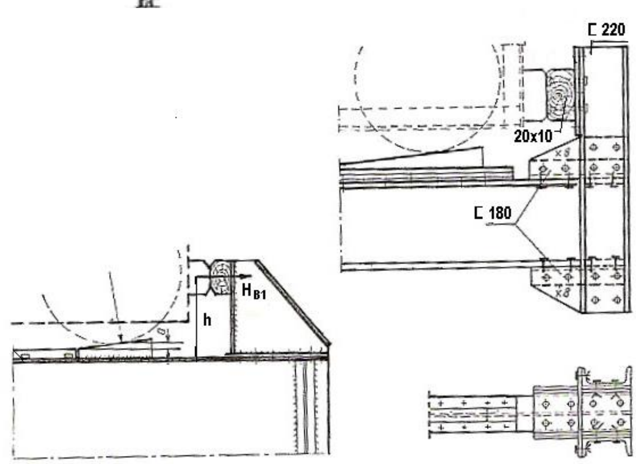


Fig.8.7 Runway beam with a bumper block - example

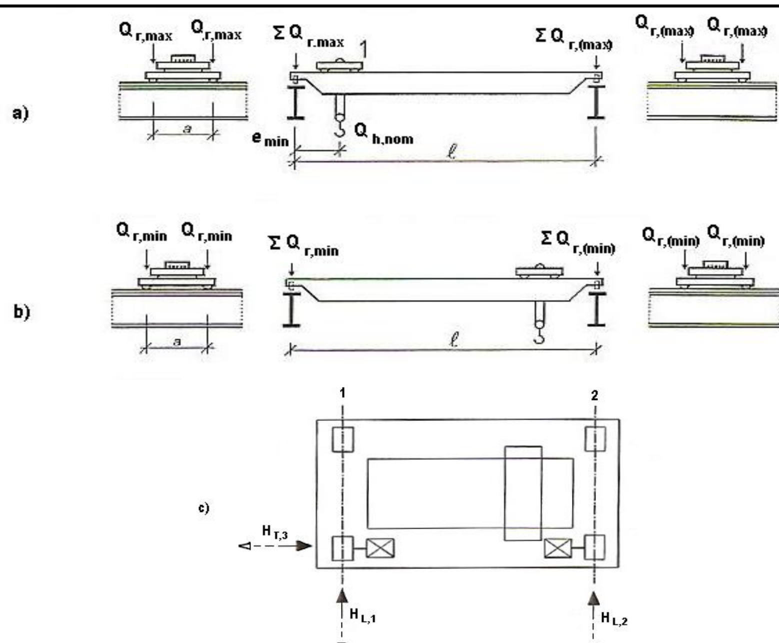


Fig.9.6 Actions induced by cranes: a) maximal vertical loads b) minimal vertical loads, c) horizontal loads from braking and accelerating acc. to EN 1991-3: 2006

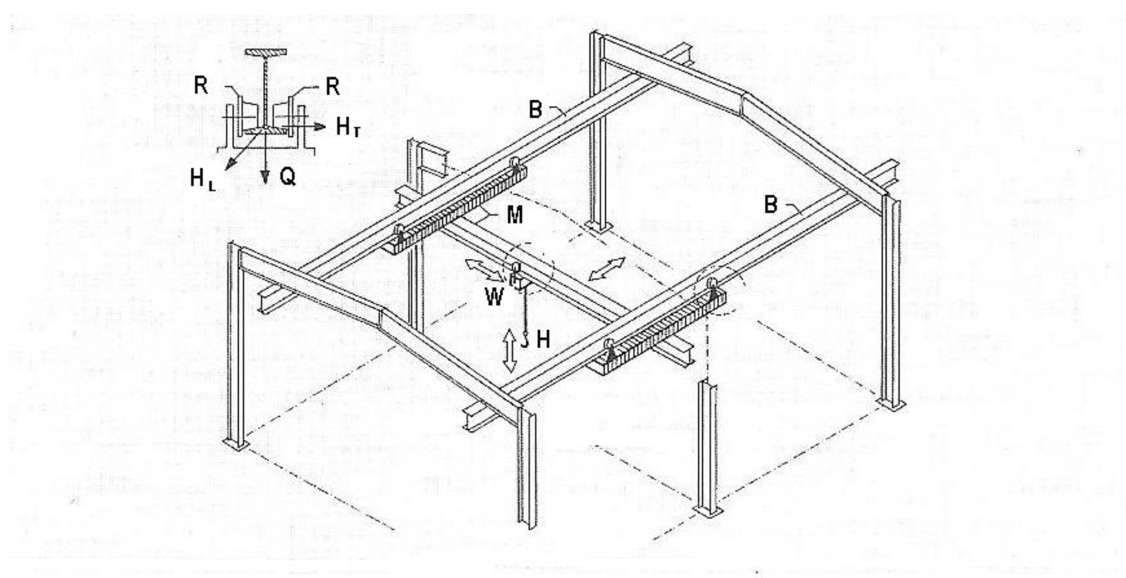


Fig.9.5 Isometric view on single girder underhung crane: B-runway beam, M- crane bridge, W- trolley, H- hook, R- crane wheel

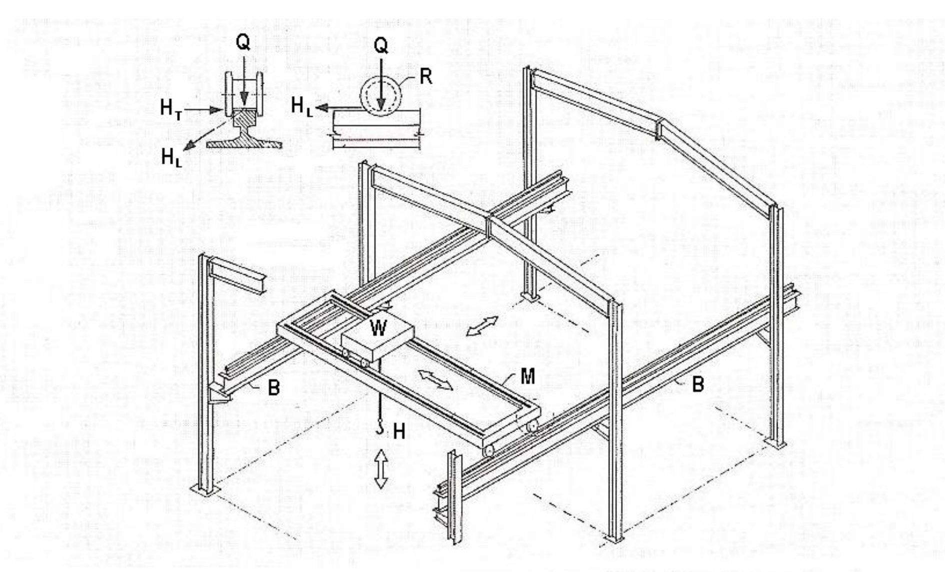
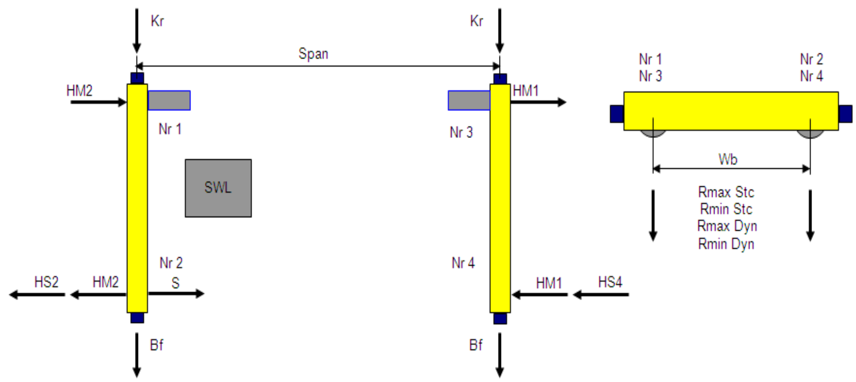


Fig.9.4 Isometric view on top running bridge crane: B- runway beam, M- crane bridge, W- trolley, H- hook, R- crane wheel



Vertical wheel loads

Wheel	NR1	NR2	NR3	NR4
Rmax Stc	82,0 kN	74,5 kN	-	-
Rmin Stc	-	-	25,1 kN	20,0 kN
Rmax Dyn	97,2 kN	88,4 kN	-	-
Rmin Dyn	-	-	28,4 kN	22,7 kN

5.1	Inertia forces (from driving mechanisms)	HM1 = 2,0 kN	HM2 = 7,1 kN
5.2	Max. Wheel loads along each crane runway		Kr = 2,8 kN
5.3	Buffer force for dimensioning the crane runway end stop		Bf = 60 kN
5.4	Forces coming from skewing		
5.4.1	Guiding (contact) force (S= HS2 + HS4)		S = 26,0 kN
5.4.2	Friction forces due to oblique travel	HS2 = 20,2 kN	HS4 = 5,8 kN

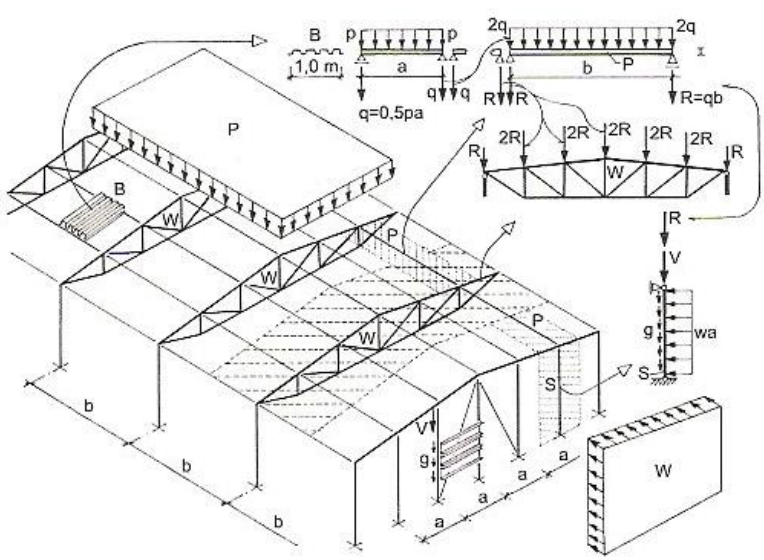


Fig.9.1 Scheme of load distribution on structural elements

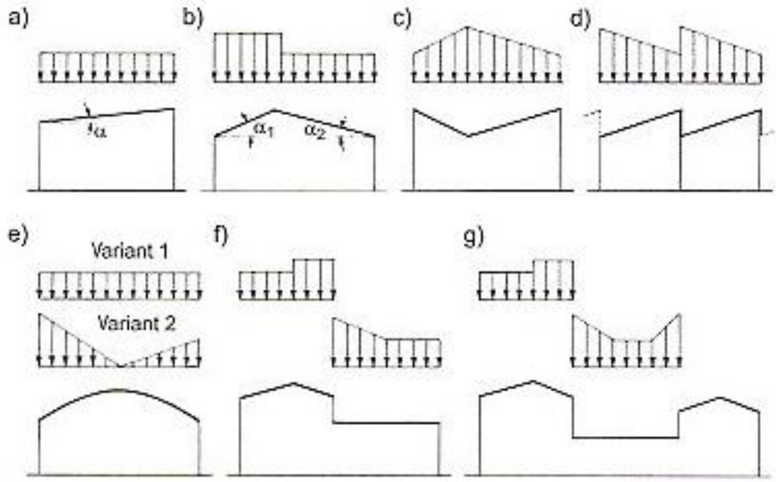


Fig.9.2 Chosen schemes of snow load

Snow load on roofs – Load arrangements

For situations where the wind velocity increases above 4 ÷ 5 m/s snow particles can be picked up from the snow cover and re-deposited on the lee sides, or on lower roofs in the lee side, or behind obstructions on the roof.

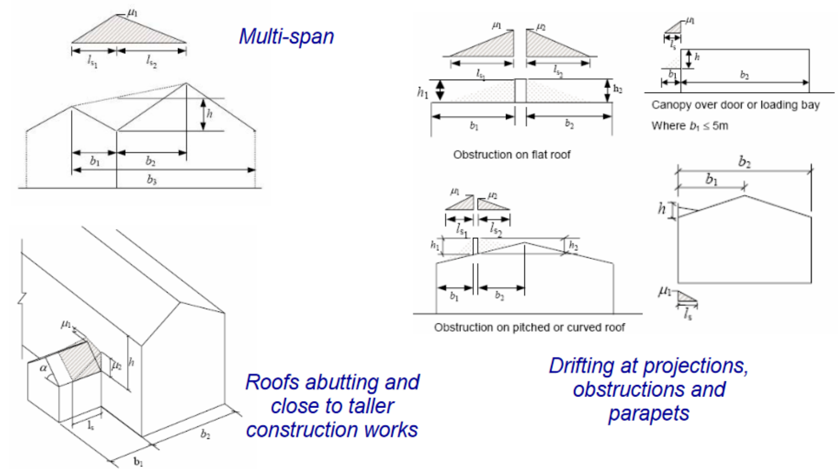
DRIFTED SNOW LOAD ARRANGEMENT

Model in wind tunnel for multi - pitched roof
wind velocity > 5 m/s

Paolo Formichi, University of Pisa Italy

Snow load on roofs – Shape coefficients

Annex B of EN 1991-1-3 gives shape coefficients for the following types of roofs (*exceptional drifted cases*):



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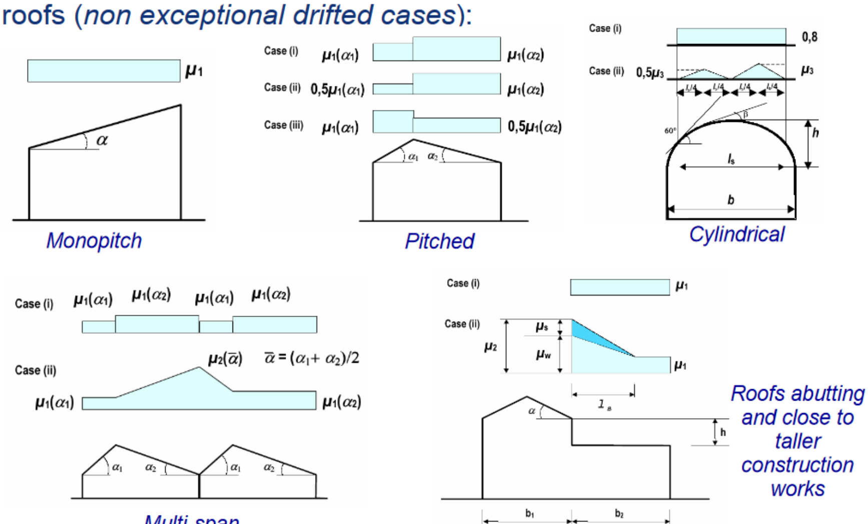
Snow load on roofs – Shape coefficients

EN 1991-1-3 gives shape coefficients for the following types of roofs (*non exceptional drifted cases*):



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Snow load on roofs – Shape coefficients

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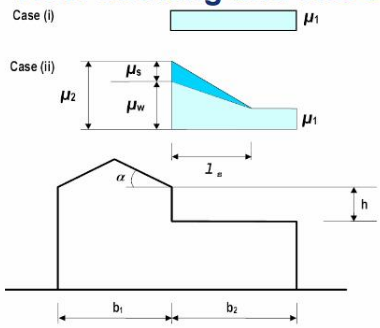
Roof abutting and close to taller construction works



μ_s is for snow falling from the higher roof (α>15°)

μ_w is the snow shape coefficient due to wind:

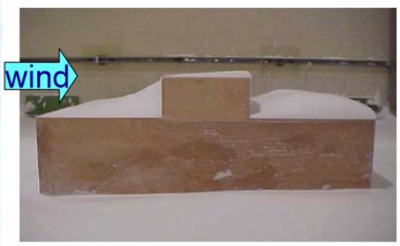
$$\mu_w = (b_1+b_2)/2h < \gamma\, h / s_k$$

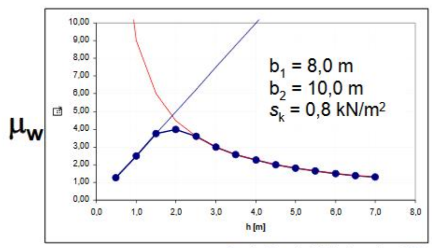
$$\gamma = 2 \text{ kN/m}^3$$

$$0.8 < \mu_w < 4$$

$$l_s = 2h$$

$$5\text{m} < l_s < 15\text{m}$$





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Snow load on roofs – Collapse due to drifting (2)

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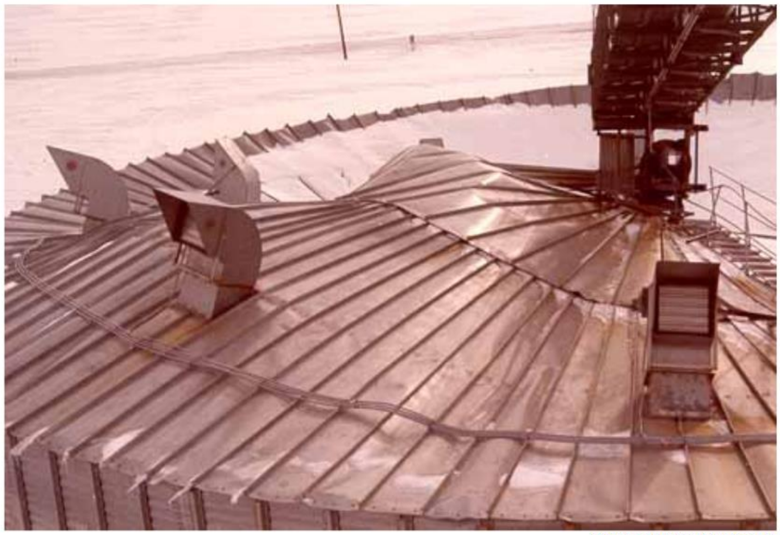
Collapse of a silo roof due to unbalanced snow deposition pattern



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Snow load on roofs – Collapse due to drifting (1)

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17th February 2003 – Collapse due to heavy snow storm unbalanced load on half roof

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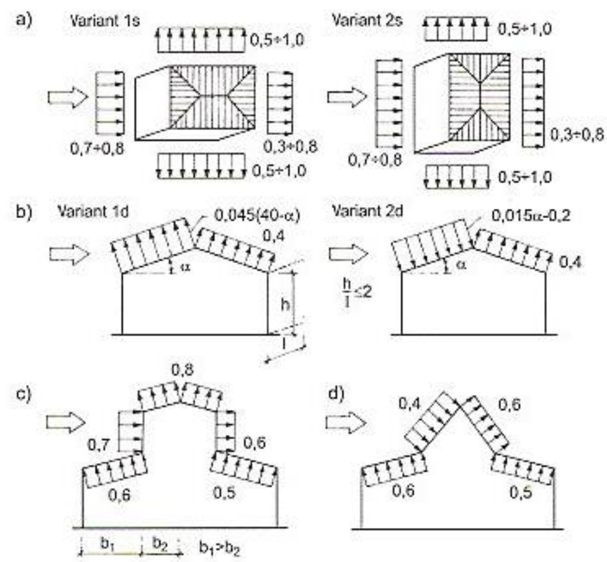

Fig.9.3 Examples of wind load assumed in Poland