AUTHORIZATION FOR THE CONSTRUCTION AND THE USE OF METALLIC SCAFFOLDING MADE OF PREASSEMBLED FRAMEWORKS FOR CONSTRUCTION WORKS

Prefabricated frame scaffoldings with bush type 105

GIE - 180

CHAPTER IV

EVALUATION OF SCAFFOLDING IN DIFFERENT NORMAL WORKING CONDITIONS

4.1 Premise

The evaluation refers to the controls of strength and stability of the supporting structure mentioned in Chapter I, together with the controls of sample plans annexed to this paper.

The paperwork has been written in accordance with the following laws, regulatory and administrative provisions[1]:

A-PROVISIONS LAID DOWN BY LAW

1-Presidential Decree April 27, 1955, n.147- Specifications for accident prevention
2-Presidential Decree January 7, 1956 n.164-Specifications for accident prevention in buildings
3-Presidential Decree May 24, 1988 n.224-Liability for damage from defect in material
4-Legislative Decree September 1994, n.626-Implementation of the Directives 89/391/EEC, 89/654/ECC, 89/655/ECC, 89/656/ECC, 90/269/ECC, 90/270/ECC, 90/394/ECC, and 90/679/ECC concerning the improvement of workers' safety and health conditions at work.
5-Legislative Decree March 17, 1995 n.115-Products general safety
6-Legislative Decree August 4, 1999 n.359-Implementation of the Directive 95/63/ECC which modifies the Directive 89/655/ECC concerning the minimal safety and health requirements for the use of work equipment by workers
7-Legislative Decree July 8, 2003 n.235-Implementation of the Directive 2001/45/ECC concerning the minimal safety and health requirements for the use of work equipment by workers

B – REGULATORY PROVISIONS

a-Ministerial Decree of the Ministry of Employment and Social Affairs September 2, 1968 (Effectiveness Acknowledgement)
b-Ministerial Decree of the Ministry of Employment and Social Affairs March 23, 1990 n.115 (Effectiveness Acknowledgement)
c-Ministerial Decree of the Ministry of Employment and Social Affairs May 22, 1992 n.466 (Effectiveness Acknowledgement)

C-ADMINISTRATIVE ACTION

- Circular of the Ministry of Employment and Social Affairs n.85/78 of 9/11/78-Authorization for the construction and the use of fix metallic scaffolding
- Circular of the Ministry of Employment and Social Affairs n.22268/PR-7 of 22/5/82-Size Requirements
- Circular of the Ministry of Employment and Social Affairs n.149/85 of 22/11/85-Rules governing the construction and the use of fix metallic scaffolding

[1] All the provisions belong to the Italian legislation.

- Circular of the Ministry of Employment and Social Affairs n. 44/90 of 15/5/90-Update of the instruction for the compilation of technical reports for fix metallic scaffolding and preassembled frameworks
- Circular of the Ministry of Employment and Social Affairs n.20298/OM-4 of 9/2/95-Use of authorized prefabricated scaffolding parts instead of scaffolding wooden parts
- Circular of the Ministry of Employment and Social Affairs n.22787/OM-4 of 21/1/99-Instruction for the compilation of technical reports, observations and clarification
- Circular of the Ministry of Employment and Social Affairs n.44 of 10/07/00-Verifications and checks, conservation modalities and related documents in Legislative Decree 359/99
    - Circular of the Ministry of Employment and Social Affairs n 46 of 11/07/00 – Safety assessments of metal scaffoldings
    - Circular of the Ministry of Employment and Social Affairs n 20/2003 protocol. 21112/PR/OP/PONT/CIRC of 23/05/03 – Explanations regarding the mixed use of fixed metallic scaffoldings
    - Circular of the Ministry of Employment and Social Affairs n 3 of 08/01/01 Paragraph 2, 4 Legislative Decree n 359/99 – Explanations regarding the organization of the scaffoldings' periodic inspections
    - Circular of the Ministry of Employment and Social Affairs n. 20/2003 protocol. 21112/12/PR/OP/PONT/CIRC of 23/05/03 - Explanations regarding the mixed use of fixed metallic scaffoldings
    - Circular of the Ministry of Employment and Social Affairs n. 30/2003 protocol. 21571/PR/OP/PONT/CIRC of 29/09/03 – Paragraph 30 of the Presidential Decree 7 January 1956 n 164 – Explanations regarding the definition of scaffolding's "erector".

The evaluations which are not regulated by all these provisions are established in accordance with the following instructions:

C.N.R. 10011/97
C.N.R. 10012/84
C.N.R. 10022/85
C.N.R. 10027/85

4.2 LOADING EVALUATION

Loads supported by the scaffoldings are divided in

- Dead loads
- Live loads

4.2.1 Dead loads

For scaffoldings like the type described in Chapter Vii, dead loads refer to the self weight of the scaffold structure.

4.2.2 Live loads

Live loads include:

a) Working loads

For scaffoldings used for maintaining works, these loads are calculated with the following formula:

- $P_4 = N/m^2$

b) Snow loads

These loads are calculated in altitude from sea level of h_0 (m) with the following formula:

$Q_n\ \alpha_r\ \alpha_m\ \alpha_z\ (900 + 2{,}4\ n0)\ N/m^2$ where:

- α_r is the return coefficient = 1 (< 2 years)
- α_m is the exposition coefficient = 0,8
- α_z is the area coefficient = it depends on the area

Areas	Regions	h0 [m]	α_z	q_n [N/m2]
I	Valle d'Aosta, Piemonte, Lombardia, Trentino Alto Adige, Emilia Romagna, Friuli Venezia Giulia,	500	1,00	1680
II	Liguria, Toscana, Umbria, Lazio.	790	0,66	1680
III	Campania, Basilicata, Calabria, Puglia, Sardegna,	920	0,33	1680

For the inclined gravel guard β on the horizontal, as it happens for similar roofs the following considerations can be made:

$\beta \leq 30°$	Snow slides over	
$\beta \geq 60°$	Snow slides over completely	
$\beta = 41{,}41°$	Snow stays on the gravel guard	$q_{pn} = q_n \cdot \mu = 1680 \cdot \frac{60 - 41{,}41}{30} = 1041\ N/m^2$
	Snow slides over on the plank	$q^*_{pn} = q_n \cdot (1-\mu) \cdot \frac{1{,}5}{1{,}05} = 1680 \cdot 0{,}38 \cdot \frac{1{,}5}{1{,}05} = 912\ N/m$

where
1,5 is the overhang of the gravel guard
1,0 is the width of the coupling planking.

c) action of the wind.

The action of the wind considered as an horizontal action, determines a force F which can be calculated with the following formula:

where:

The kinetic pressure pv can be calculated with the following formula

$$p_V = \frac{(\alpha_t \cdot \alpha_r \cdot \alpha_z \cdot V_{rif})^2}{1{,}6}$$ where:

- αt, topographic coefficient = 1
- αr, return coefficient = 0,93 (for a return period < 20 years)
- αz, profile coefficient is calculated according to the point 5.2.4.3 of the CNR rule.
-

10012/84; values are calculated with the following formula $\alpha_z = K \cdot \ln\left(\frac{z}{z_o}\right)$ where for the category III

[Suburban or industrial areas, woody or hilly areas, or other types of land with obstacles of an average height not inferior to 4 metres. A given building is included in Category III when it is surrounded by this type of land for at least 500 m or for no less than ten times its height] as established by the Ministerial Circular n° 44/90, K = 0,22, zo = 0,30 m, z is the height of calculation and must be more than z1 = 7 m.

- The gust coefficient Gr is calculated according to point 5.3 of the CNR rule 10012/84; the values can be calculated with the following formula:

$G_r = 1 + 1{,}12 \cdot \left(\frac{\alpha_d}{\alpha_z}\right)$ where:

- αd=l
- zo = 0,30 m
- az is equal to the value listed above.

Taking the following values as velocity of reference V_{rif}:
- V_{rif} = 16 m/s for the working condition
- V_{rif} = 30 m/s for the no working condition

The values of the products of the kinetic pressure and the gust coefficient are provided in the annexed table for the different floors of the scaffolding.

			working	no working
Height.	α_z	G_r	$P_v \times G_r$ [N/m^2]	$P_v \times G_r$[N/m^2]
2	0,69	2,62	174	611
4	0,69	2,62	174	611
6	0,69	2,62	174	611
8	0,72.	2,55	184	647
10	0,77	2,45	202	710
12	0,81	2,38	217	763
14	0,85	2,32	230	808
16	0,87	2,28	242	849
18	0,90	2,24	252	886
20	0,92	2,21	261	919
22	0,94	2,19	270	_949

- The surface S is the projection – on plane which is normally exposed to the action of the wind - of the surface of the scaffolding affected.

- The form coefficient C is:
  C = 1,2 for the structure of the scaffolding
  C = 1,3 for the toe board screens

d) Loads for local assessments:

- The ministerial circular No 44/90 establishes for a horizontal thrust, concentrated in the middle line, the following tests:
  - Assessment of the elastic and sweep strain with the following data:

Thrust [N]	Sweep
300	< 35 mm

■ Assessment of the sweep with the following data:

Thrust [N]	Sweep
1250	< 200 mm

- Planking:

In a construction scaffolding, alternatively to the working load, the heaviest action of the following ones must be considered:

Load uniformly allocated [N/m^2]	3000
Load allocated on a surface of 500x500 mm [N]	3000
Load allocated on a surface of 200x200 mm [N]	1000
Load on a partial surface [N/m^2]	5000
Partial surface	0,4 $A_{impalcato}$

4.3 LOADING CONDITIONS

4.3.1 Working Condition

- Working load on a plank
- 50% of a working load on a second plank
- Action of the wind forecast for the working condition

4.3.2 No Working Condition

In a scaffolding, alternatively to the working condition, the heaviest condition among the following ones must be considered:

normal no working condition

(N.B. Since this condition is automatically verified it will be ignored; alternatively, another working condition will be analysed)

- Weight
- 50% of the working load on a plank
- Wind for the no working condition

No working condition with snow

- Weight
- Complete snow load on the highest plank
- Complete snow load on the gravel guard
- 30% of the complete snow load on the planks and the gravel guard underneath
- Wind for the no working condition.

4.4 ASSESSMENT CRITERIA

The assessment is carried out by comparing the results with the allowable stress method and with the experimental results.

4.4.1 Allowable stress method

The type of steel used is S235, corresponding to the following type which is set out by the CNR 10011 rule.

For the first loading condition the allowable stress is:

σ_{amm}= 160 N/mm^2 for the S235 steel (ex Fe 360)

For the second loading condition the allowable stress is increased by 12,5 %:

σ_{amm}= 180 N/mm^2 for the S235 steel (ex Fe 360)

4.4.2 Comparison with tested data

If a deterministic approach is used, the maximum action to assess is compared to the minimum values resulting from experimental tests. Such ratio must be higher than 2.2.

If a probabilistic approach is used, relying on the values resulting from the tests, the value which can occur in 95% of the cases can be calculated:

$$P_{medio.} = \frac{\sum_{1}^{n} P_i}{n}$$

$$s_{y.} = \sqrt{\frac{1}{n-1} \cdot \sum_{1}^{n} \left(P_i - P_{medio}\right)^2}$$

K_s = it depends on the number of tests

$$P_{95\%.} = P_{medio} - k_s \cdot s_y$$

The ratio between the maximum action to be assessed and $P_{95\%}$ must exceed 1.5.

4.5 SCAFFOLDING ASSESSMENT CALCULATION

4.5.1 Scaffolding features

a) Functional features

The scaffolding which must be tested is aimed at building works and the estimated working load is $q_4 = 3000$ N/mm^2.

The bent has a distance between standards of 1050 mm e a distance of 1800 mm between bays

b) Structural features

Normal plan

The normal plan of the scaffolding, made with the components previously described, has the following features:

- Maximum Nº of floors : 10;
- Height of a floor: 2.0 m;
- Distance between frames: 1.8 m;
- Distance between the standards of the same frame: 1.05 m;
- Nº of façade braces in every modulus of each floor: n°1
- Nº of braces on the floor plan: 1 in every modulus of every floor for anchored floors;
- Nº of universal anti pull-out hooks: 1 for every connection between standards;
- Nº of gravel guards with planks: 1 for every bay and if possible continuously on the same floor after the first;
- Nº anchorages. One anchorage with alternate frames, for the 5th, 7th, 9th and 11th floor, at least one anchorage every 14.4 m²;
- Nº anchorages on the floors concerned by the gravel guard, 2nd, 3rd , (floor for the connection with the gravel guard and subsequent floor): one anchorage for every frame, for everyone of the two floors;
- Maximum height of the support floor on the edge of the scaffolding of the last viable floor: 20 m;

- Special anchorages, to take up the actions parallel to the façade, every 6 frames

4.6 ACTION ASSESSMENT

4.6.1 Generalities

The action assessment is carried out for the scaffolding of the project plan-Annex A equipped with gravel guard

a) Weight

Frame	G1	205 N
Longitudinal bar	G2	28,5 N
Façade braces	G3	36 N
Peg	G4	1,35 N
Gravel guard (complete structure)	G5	180 N
Plank	G6	150 N
Toe board	G7	132 N

b) Surfaces exposed to wind

The projections of a scaffolding modulus on a parallel plane and on a normal plane to the building under construction (plane and field).

PROSPECTUS IA

Wind normal to the building under construction

Exposed elements	size		n°	areas
	length	diameter/height		[m2]
Standards	2,00	0,0483	2	0,193
Upper breastwork longitudinal	1,80	0,0269	1	0,048
Lower breastwork longitudinal	1,80	0.0269	1	0,048
Façade braces	2,12	0,0269	1	0,057
		total S1 n		0,348
Toe board	1,80	0,2	1	0,360
Planks	1,80	0,048	1,1	0,095
(*) + 5 % for each element		total S2 n		0,456
		total Sn = (S1 n + S2 n) x1,05		0,844

PROSPECTUS I B

Wind parallel to the building
under construction

Exposed elements	size		n°	areas
	lunghezza	diam./alte		[m2]
standards	2,00	0,0483	2	0,1932
Struts	1,00	0,0483	1	0,0483
Small bay	1,53	0,0269	1	0,0411
1st breastwork longitudinal bar	1,05	0,0483	1	0,0507
2 nd breastwork longitudinal bar	1,05	0,0483	1	0,0507
		total S1 p		0,384
Toe board	1,25	0,2|	1	0,250
	total S2 p			0,250
	total Sp = S1 p + S2 p)x 1,05			0,666

By assessing the force of the wind per surface unit as described in point 4.2.2 and in prospectuses IA and IB, the effects of the wind can be calculated for each floor of the planking.

The horizontal action of the wind determines a force Fv acting on the structure nodes, which can be calculated with the following formula f_v = pv ·G_r·C·L·k, where:
pv ·G is calculated in section 4.1.2
C is equal to 1,2
Sp [m2] = 0,666
Sn [m2] = 0,844
[N], [m]

N'	z	F' vn exercise	F'' vn f.exercise	F'vp exercise	F'' vp f.exercise
1	2	176	619	139	488
2	4	176	619	139	488
3	6	176	619	139	488
4	8	186	656	147	517
5	10	205	719	161	567
6	12	220	772	173	609
7	14	233	819	184	646
8	16	245	860	193	679
9	18	255	897	201	708
10	20	264	931	209	734
11	22	273	961	216	759

A force acts on gravel guard which can be calculated by the following formula:
f_v = p_v ·G_r·C·L·k

$p_v \cdot G_r$ is calculated in section 4.1.2 on the 3rd floor
C is equal to 1,3
L is equal to l,8m
k=sen 41,41°
[N/m]

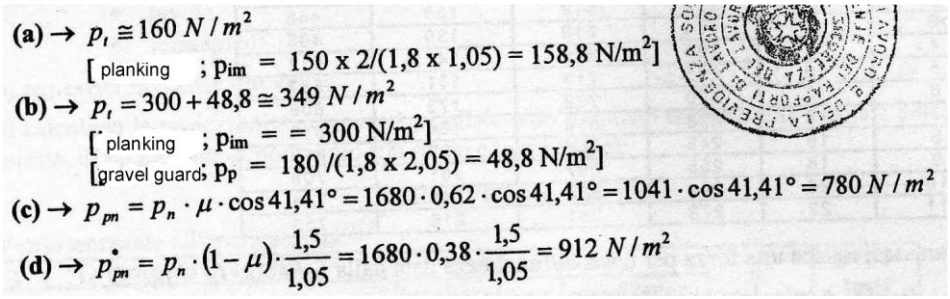
Gravel guard	
f' v exercise	f" v exercise
320	1125

4.6.2 Actions allocated on the ledgers

PROSPECTUS III

Type of action	**Allocated load (N/m^2)**	**Actions (N/m^2)**
Planking weight	p_1= 160	q_1= 288
Working load cl. 4	P_2 = 3000	q_2 = 5400

Planking + gravel guard weight	p_3 = 349	q_3 = 628
Snow h_0 = 500 m (from water level) (point 4.2.2 b)	p_n = 1680	q_n = 3024
Snow on planks underneath	p_n= 504	q_n = 907
Snow on gravel guard	p_{pn}= 780	q_{pn}= 1404
Snow on coupling between plank and gravel guard	p'_n= 912	q'_n = 1642



(a) → $p_t \cong 160\ N/m^2$

[planking ; p_{im} = 150 x 2/(1,8 x 1,05) = 158,8 N/m²]

(b) → $p_t = 300 + 48{,}8 \cong 349\ N/m^2$

[planking ; p_{im} = = 300 N/m²]

[gravel guard; p_p = 180 /(1,8 x 2,05) = 48,8 N/m²]

(c) → $p_{pn} = p_n \cdot \mu \cdot \cos 41{,}41° = 1680 \cdot 0{,}62 \cdot \cos 41{,}41° = 1041 \cdot \cos 41{,}41° = 780\ N/m^2$

(d) → $p^*_{pn} = p_n \cdot (1-\mu) \cdot \frac{1{,}5}{1{,}05} = 1680 \cdot 0{,}38 \cdot \frac{1{,}5}{1{,}05} = 912\ N/m^2$

4.6.3 Vertical axial actions owing exclusively to the frame components except boards

Axial actions owing to structural parts except the boards act on the standards on each floor

Prospectus IV A – Load on the outside standard [Nl, [mm]

element	*length/step*	***weight***	***n°***	**Area involved**
frame	2000	205	0,5	102,
Breastwork longitudinal bar	1800	28,5	2	5
Facade brace	1800	36	1	3
Toe board	2200	132	1	13
peg	-	1,35	1	1.3
			Pe A	328,8

Prospectus IV B - Load on the inside standard

[N], [mm]

element	*length/step*	***weight***	***n°***	**Area involved**
frame	2000	205	0,	102,5
peg	-	1,35	1	1,35
			Pe B	103,85

4.6.4 Vertical and horizontal axial actions

The horizontal forces are due to:

- Wind
- Geometrical deformities (CNR 10027): equivalent horizontal actions are equal to 1/100th of the vertical acting forces

The horizontal forces absorbed by the vertical brace are calculated as follows:

F ***vertical brace*** = $F_{vp} + n \cdot \left(\frac{Pe}{100} + \frac{Pi}{100}\right)$ Where n=1 which is the number of bays affected by a counterwind brace

$$F_{vertical\ brace} = \max\left\{\left(\frac{F_{vp}}{2}+\frac{Pe}{100}\right);\left(\frac{F_{vp}}{2}+\frac{Pi}{100}\right)\right\}$$

Prospectus V A - Vertical actions in the working condition

Progressive Vertical Actions			
floor	**Pe [N]**	**Pi [N]**	**Ptot [N]**
1st	10577	6589	17166
2nd	10099	6335	16433
3rd	8360	6081	14440
4th	7881	5827	13708
5th	7402	5573	12975
6th	6923	5319	12242
7th	6444	5065	11510
8th	5965	4812	10777
9th	5487	4812	10298
10th	5008	4558	9565
11th	3179	2954	6133

Prospectus V B - Horizontal actions in the working condition

floor	Pe/100 [N]	Pi/100 [N]	F^1vn [N]]	F^1vn tot [N]	F^1vp [N]
1st	106	66	176	348	139
2nd	101	63	176	341	139
3rd	84	61	176	321	139
4th	79	58	186	323	147
5th	74	56	205	334	161
6th	69	53	220	342	173
7th	64	51	233	348	184
8th	60	48	245	353	193
9th	55	48	255	358	201
10th	50	48	264	360	209
11th	32	30	273	335	216

Prospectus V C - Vertical actions in the no working condition with snow

Progressive vertical actions			
floor	**Pe [N]**	**Pi [N]**	**Ptot [N]**
1st	11420	5579	16999
2nd	10941	5325	16266
3rd	6275	4250	10526
4th	5796	3996	9793
5th	5318	3743	9060
6th	4839	3489	8327
7th	4360	3235	7595
8th	3881	2981	6862
9th	3402	2727	6129
10th	2923	2473	5397
11th	1991	1766	3757

Prospectus V D - Vertical actions in the no working condition

						Façade brace		**Metallic board**		
(1)	(2)	(3)	(4)	(5)		$(5) + [(1) + (2)]$		$\frac{(5)}{2} + (1)$	$\frac{(5)}{2} + (2)$	-
floor	**Pe/100 [N]**	**Pi/100 [N]**	**F"vn [N]**	**F"vn tot [N]**	**F"vp [N]**	**F"vp tot [N]**	**F"vp max [N]**	**F"vpe tot [N]**	**F"vpi tot [N]]**	**F"vp max [N]]**
1°	114	56	619	789	488	658	-	358	300	-
2°	109	53	619	782	488	651	-	354	297	-
3°	63	43	619	724	488	594	-	307	287	-
4"	58	40	656	754	517	615	-	317	299	-
5°	53	37	719	810	567	658	-	337	321	-
6°	48	35	772	856	609	693	-	353	340	-
7°	44	32	819	895	646	722	-	367	355	-
8°	39	30	860	929	679	747	-	378	369	-
9°	34	27	897	958	708	769	-	388	381	-
10°	29	25	931	984	734	788	788	396	392	396
11°	20	18	961	999	759	796		^ 399	397	-

4.7 SCAFFOLDING ASSESSMENT

The assessment on strength and stability of the supporting structure required by Circular M.L.P.S. No 44/90 is described below.

4.7.1 Assessment of the standards within the normal scheme

The calculation of the amplification coefficients of vertical loads and reduction coefficients of resisting sections result from the collapse test carried out on scaffoldings having bays of 1800 mm.

To sum up:

$A = 413\ mm^2$

$fy = 235\ N/mm^2$

$$\lambda_c = \pi \cdot \sqrt{\frac{E}{f_y}} = \pi \cdot \sqrt{\frac{206000}{235}} = 93{,}01$$

[N], [N/mm2]	Certified by Politecnico of Milano
	n° 2004/1050 del 07/04/04
P / 2	35295
$\sigma c = (P_{cr} / 2)/A$	85,460
σ_c / f_y	0,364
$\lambda / \lambda c$ (2)	1,5425
λ	143,468
ω (3)	2,760
σ_{cr} (4)	98,500
$N_{cr} = \sigma_{cr} \cdot A$	40681

(1) Prototype of metallic preassembled frame scaffoldings, step of 1800 mm with metallic planks on all floors

(2) Prospectus 7-1 of the CNR 10011 instructions

(3) Prospectus 7-II of the CNR 10011 instructions

(4) Prospectus 7-VII of the CNR 10011 instructions

The stress on the standards is verified according following formula:

Stability assessment $$\sigma_1 = \frac{\omega \cdot N}{A} + \frac{M_{eq}}{W \cdot \left(\Phi - \frac{\mu \cdot N}{N_{cr}} \right)} \leq \sigma_{amm}$$

Strength assessment $$\sigma_2 = \frac{N}{A} + \frac{M_{max}}{W} \leq \sigma_{amm}$$

where:
N is the axial load on the standard
A is the standard section (413 mm^2)
ω is the amplification coefficient of loads corresponding to the resulting slenderness resulting from the loading tests (2,76)

M_{eq} is the equivalent moment, taken into consideration, as indicated at point 7.4.1.1 of the CNR 10011 instructions.

a) In case of variable moment along the bar with values at the ends of opposite sign M_{eq}= 0.6 M_a – 0.4 M_b with $[M_a] \geq [M_b]$ if $M_{eq} \geq 0{,}4\ M_a$

b) In case of variable moment along the bar with values at the ends of same sign or in case of variable moment not along the bar M_{eq}= 1.3 M_{medium} with the limitation 0,75 $M_{max} \leq M_{eq} \leq M_{max}$

- Φ is the factor of plastic adaptation, prudentially estimated as equal to 1;
- μ the safety coefficient related to the concerned loading condition (μ = 1,33 for the second loading condition)
- $N_{cr} = \sigma_{cr}$ * A (**40681** N) with σ_{cr} as critical tension calculated with Eulero's Formula, for the slenderness considered
- W is the Modulus of resistance of the standard (4430 mm^3)

Strains and tensions reported below come from Annex 1 **[daN, daNcm, daN/cm^2]**

standard	condition	comb	Ma	Mb	M_{max}	0,75 M_{max}	M_{medium}	M_{eq}	N	ω N/A	μ	M/[W(l-μ N/Ncr)]	σ_1	σ_1
Outside first floor (bars 3-4)	exercise	1	510	3276	—	—		204	984	658	1,5	48	706	353
		2	—	—	960	720	488	720	1045	699		169	868	470
	No normal exercise	3		3776	620	465	335	465	984	658	1,33	109	767	378
		4	—	—	539	404	354	460	1044	698		108	806	374
	No normal exercise with	5		3774	1277	958	714	958	1065	712		224	936	546
		6	—	—	1344	1008	850	1105	1209	808		260	1068	596
Outside second floor (bars 11 and 12)	exercise	1	680	-627	—	—	—	272	943	631	1,5	64	695	382
		2	2461	-1829	—	—	—	984	988	660		231	891	795
	No normal exercise	3	943	-940	—	—		377	975	652	1,33	88	740	449
		4	-1163	1163	—	—	—	465	988	660		109	769	502
	No normal exercise with	5	2083	-1888				833	1091	730		196	926	734
		6	2883	-2694	—	—	—	1153	1133	758		271	1029	925
Inside First Floor (bars 1-2)	exercise	1			963	722	453	722	804	538	1,5	168	706	412
		2	-598	50	—	—	—	339	745	499		79	578	315
	No normal exercise	3		—	542	406	319	415	803	537	1,33	97	634	317
		4	—	—	708	531	369	531	745	499		123	622	340
	No normal exercise with	5	—	—	1258	944	781	1016	751	502		236	738	466
		6		—	1448	1086	779	1086	611	409		251	660	475
Inside second floor (bars 9 and 10)	exercise	1	-2508	1857	—	—	—	1003	768	514	1,5	234	748	752
		2	-563	542	—	—		225	724	484		53	537	302
	No normal exercise	3	-1209	1191	—	—	—	484	768	514	1,33	112	626	459
		4	-907	878	—		—	363	752	503		84	587	387
	No normal exercise with	5	-2966	2745	—	—	—	1186	696	465		275	740	838
		6	-2009	1761			—	804	648	433		186	619	610

By considering the following possible tensions:
a) exercise condition
σ_{amm} = 1600 daN/cm2
b) no exercise conditions
σ_{amm} = 1800 daN/cm2
Tests are successful.

4.7.2 Assessment of the local stiffening plates both in front and in plan views

NOTE: Scaffold stability is achieved by tying the scaffold to horizontal supporting structures with "special" anchorages placed at intervals of six bays (as reported in Annex A) and capable of resisting to actions with a degree of safety of minimum 2.5. Considering that the working area of these anchorages is equal to 2 floors x 6 ranges (4,3 m^2)and the maximum horizontal strength of the façade brace calculated in the prospectus VD (N = 788 N) is equal to 1 floor x 1 range (0,666 m^2), this anchorage as to support N = (4,3 / 0,666) x 788 =5088 N

4.7.2.1 Façade braces

• Curved tube	d/s	26,9/2,3	mm
• Section Area	A	177	mm^2
• Section modulus	W	1008	mm^3
• Radius of gyration	i	8,7	mm
• Length of a component	l	2100	mm
• Slenderness	λ	242	
• Amplification coefficient[1]	∞	7,25	
• Eulerian stress[1]	σ_E	35	N/mm^2
• Angle of inclination with the longitudinal bar	α	34,72	°
• Max. eccentricity of the diagonal brace's axis with the support	e	13,5	mm

[1]q.v. tables 7IIa and 7-VII of the Standard CNR 10011

Assessment

The Prospectus V D reports the maximum action which the façade brace has to support N = 788 N

$$F_{st} = \frac{N}{\cos(\alpha)} = \frac{788}{\cos(34{,}72°)} \cong 960\ N$$

$$\sigma = \frac{\omega \cdot F_{st}}{A} + \frac{F_{st} \cdot e}{W \cdot \left(1 - \frac{1{,}33 \cdot F_{st}}{\sigma_{cr} \cdot A}\right)} = \frac{7{,}25 \cdot 960}{177} + \frac{960 \cdot 13{,}5}{1008 \cdot \left(1 - \frac{1{,}33 \cdot 960}{35 \cdot 177}\right)} \cong 56\ N/mm^2 < 180\ N/mm^2$$

According to the compression tests reported in the ENPI PTP 161662-161666 certificate of 03/04/74, $P_{95\%}$ =1959N

$$\mu = \frac{1959}{788} = 2{,}48 > 1{,}5$$

4.7.2.2 0,49x1,80 board

The Prospectus V D reports the maximum actions which the structural boards has to support:

- Parallel boards N = 369 (q.v. prospectus VD)
- Perpendicular boards N = 1917 (the maximum action occurs in no working conditions with snow and wind; q.v. Annex 1)

The compression tests reported in the certificate of the Institute of Technology of Milan No 2004/1052 of 07/04704 provide the value for the assessment of the parallel structures: $P_{95\%}$ = 9540 N. regarding the perpendicular actions this value is reduced to 1,05/1,8 =0,584

According to the same certificate, the safety coefficients are

a) For wind orthogonal to the façade floor $\mu_{n,comp} = \frac{n_d \cdot P'_{95\%}}{F'_{d,n}} = \frac{2 \cdot 9540 \cdot 0.584}{1917} = 5{,}8 > 1{,}5$

where n_d is the number of working ranges

b) For wind parallel to the façade floor $\mu_{p,comp} = \frac{P'_{95\%}}{F'_{d,p}} = \frac{9540}{396} = 24{,}0 > 1{,}5$

4.7.3 Assessment of the ledger

Ledger

- Tube ø/s 48,/2,9 mm
- Section modulus W 4430 mm^3
- Bent spacing a 1050 mm
- Bay spacing l 1800 mm

Ledger is placed on three standards at uniform distances from each other.
The most adverse condition for the ledger's deflection occurs when the frame supports both the work load and the boards' load; according to the results of table III . q = 288+5400 = 5688 N/m

Considering a freely supported beam in accordance with safety standards:

$$M_{\sigma} = 5688 \cdot \left(\frac{1{,}05}{2}\right)^2 \cdot \frac{1}{8} \equiv 195{,}97\ Nm$$

A maximum stress corresponds to this one:

$$\sigma = \frac{195970}{4430} \cong 45\ N/mm^2 < 160\ N/mm^2$$

4.7.4 Assessment of the breastwork longitudinal bar

- Curved tube ø/s 26,9/2,3 mm
- Moment of inertia J 13563 mm^4
- Section modulus W 1008 mm^3
- Bay spacing l 1800 mm

The assessment is carried out according to the action Q = 300 N on the centre line of the guard rail bar.
Under this action the formula is

$$M_{max} = 300 \cdot \frac{1{,}8}{4} = 135\ Nm$$

$$\sigma = \frac{M_{max}}{W} = \frac{135000}{1008} = 134\ N/mm^2 < 160\ N/mm^2$$

Under this action Q = 300 N the deflection is:

$$f = \frac{1}{48} \cdot \frac{Q \cdot (a)^3}{EJ} = \frac{1}{48} \cdot \frac{300 \cdot (1800)^3}{206000 \cdot 13563} = 13\ mm < 35\ mm$$

If the deflection is in the elastic range, under the action QF = 1250 N it will correspond to:
f = fx 1250/300 = 54 mm < 200mm

The ENPI PTP 161682-161686 of 03/04/74 certificate reports a minimum collapse value equal to Nr = 1300 N

$$\mu = \frac{1300}{300} = 4,3 > 2,2$$

4.7.5 Assessment of the peg

Round	d	10	mm
Section area	A	78	mm^2
Bent spacing	l	1050	mm
Floors spacing	h	2000	mm

During the scaffolding's erection two floors could exist without any anchorage and it is considered the possibility of wind in no working conditions on two frame's ranges, laid one on the top of the other (provided with an intermediate scaffold), placed under the most elevated anchorage floor.

The prospectus V D includes the maximum horizontal actions

a. Floor 10° - N = 999 N
b. Floor 9° - N = 984 N

$$T = \frac{999 \cdot 4000 + 984 \cdot 2000}{1050} = 5680\,N$$

$$\tau = \frac{4}{3} \cdot \frac{5680}{2 \cdot 78} \cong 49\,N/mm^2 = \tau_{amm} = 104\,N/mm^2$$

Comparison with experience tests' results

The ratio between the minimum of breaking loads N_r recorded in the tests (q.v. the certificate of the Institute of Technology of Milan No 2004/1218 of 07/04/04) and the load related to the working conditions is

$$\mu = \frac{64500}{5680} = 11,36 > 2,2$$

4.7.6 Assessment of 0,49x1,80 board

In the following table there are the fixed values of the scaffold frame

Concrete plate	b-l	490-1800	mm
Area of the reactive section	A	8,48	cm^2
Moment of inertia	J	27,8	cm^4
Lower Section modulus	W_1	8,38	cm^3
Higher Section modulus	W_2	18,82	cm^3
Permissible stress	σ_{amm}	1600	N/cm^2

N°	b [mm]	h[mm]	A[mmq]	y[mm]	Sx[mm3]	ya[1][mm]	Jg[1][mm4]	Js[mm4]
1,00	396,00	1,00	396,00	47,50	18810,00	-14,29	33,00	80870,24
2,00	1,00	46,00	92,00	24,00	2208,00	9,21	16222,67	7803,01
2,00	20,00	1,00	40,00	0,50	20,00	32,71	3,33	42796,51
2,00	1,00	15,30	30,60	6,00	183,60	27,21	12,00	22654,96
2,00	omega		290,00	24,00	6960,00	9,21	83450,00	24596,43
T			848,60		28181,80		99721,00	178721,15

Js=(Jg'_T)+(Js_T) 278442,15

Barycentre position	mm	33,21	Y
Moment of inertia	mm4	278442	Jtot
Section modulus	mm3	8384	Winf
	mm3	18826	Wsuf

$$Y = \sum A_i * y_i / \sum A_i \; ; J_{tot} = \sum J_{g_i} + \sum A_i * (Y - y_i)^2 \; ;$$

$$J'_g = \frac{J_\xi + J_\eta}{2} + \frac{J_\xi - J_\eta}{2} \cdot \cos(2 \cdot \alpha)$$

Assessment

For the assessment the conditions taken into account are the scaffold load and alternatively one of the following actions

1. working load (q_1 = 300x0,49 = 147 N/m)
2. total load Q_2 = 300 N over an area of 0,5x0,5m
3. total load Q = 100 N over an area of 0,2x0,2m
4. distributed load q^1_4 =500 N/m^2 over a portion of area with a surface

A_e =0,4 $A_{scaffold}$; $A_{scaffold}$ =(0,49x2)x1,8-1,764 m^2 (A_g=0,4x1,764-0,7056m^2)
where G (board's weight) = 15,0 N; a = 1,80 cm; 1 = 0,49 m;
q_1 = G/a = 8,33 N/m
q_2 = Q_2/0,5 = 300/0,5 =600 N/m
q_3 = Q_3/0,2 = 100/0,2 = 500 N/m

A_{board} – 1x a = 0,49x1,8 = 0,882 m^2 > 0,7056 m^2
q''_4 =q'= 500 N/m
1_4 = 0,7056/0,49 = 1,44 m
q_4 = q''_4 x 1 = 500x0,49 = 245 N/m
The loads are applied in order to maximize the moments and the results are:

$$M_1 = (q_1 + q_1) \cdot \frac{a^2}{8} \equiv 63 \; daNm$$

$$M_2 = \frac{q_1 \cdot (a)^2}{8} + \frac{q_2 \cdot 0{,}5}{2} \cdot \frac{a}{2} - \frac{q_2 \cdot \left(\frac{0{,}5}{2}\right)^2}{2} = 119{,}73 \; daNm$$

$$M_3 = \frac{q_1 \cdot (a)^2}{8} + \frac{q_3 \cdot 0{,}2}{2} \cdot \frac{a}{2} - \frac{q_3 \cdot \left(\frac{0{,}2}{2}\right)^2}{2} = 45{,}7 \; daNm$$

$$M_4 = \frac{q_1 \cdot (a)^2}{8} + \frac{q_4 \cdot l_4 \cdot a}{4} - \frac{q_4 \cdot (l_4)^2}{8} \equiv 99 \; daNm$$

The loads are applied following the test plan over the support in order to maximize cuts

$$R_1 = \frac{G}{2} + \frac{q_1 \cdot a}{2} \cong 140\ daN$$

$$R_2 = \frac{G}{2} + \frac{Q_2 \cdot (1{,}8 - 0{,}254)}{1{,}8} = 265{,}2\ daN$$

$$R_3 = \frac{G}{2} + \frac{Q_3 \cdot (1{,}8 - 0{,}054)}{1{,}8} = 104{,}5\ daN$$

$$R_4 = \frac{G}{2} + q_4 \cdot l_4 - \frac{q_4 \cdot l_4^2}{2 \cdot l} \cong 220\ daN$$

For each load condition, the scaffold's deflection calculated considering the maximum moment is:

$$f_1 = \frac{5}{384} \cdot \frac{\frac{q_1}{100} \cdot (a)^4}{EJ} = \frac{5}{384} \cdot \frac{1{,}5 \cdot (180)^4}{2060000 \cdot 32{,}95} = 0{,}3\ cm$$

$$f_2 = \frac{1}{48} \cdot \frac{Q_2 \cdot (a)^3}{EJ} = \frac{1}{48} \cdot \frac{300 \cdot (180)^3}{2060000 \cdot 32{,}95} = 0{,}54\ cm$$

$$f_3 = \frac{1}{48} \cdot \frac{Q_3 \cdot (a)^3}{EJ} = \frac{1}{48} \cdot \frac{100 \cdot (180)^3}{2060000 \cdot 32{,}95} = 0{,}36\ cm$$

$$f_4 = \frac{5}{384} \cdot \frac{\frac{q_4}{100} \cdot (a)^4}{EJ} = \frac{5}{384} \cdot \frac{2{,}48 \cdot (180)^4}{2060000 \cdot 32{,}95} = 0{,}5\ cm$$

(for safety q_4 refers to all the light 1,8 m)

This values are lower than the reference values

$f_{amm} = a_2 / 100 = 1{,}8$ cm

$f^*_{amm} = 2{,}00$ cm

The maximum stresses appear

<u>In the facing</u>

$$\sigma = \frac{M_1}{W} = \frac{11973}{8{,}38} = 1430\ daN/cm^2 < 1600\ daN/cm^2$$

<u>In the support hook</u>

The round head includes three hooks, each one with the following features:

4.7.7 Assessment of the gravel guards

<u>Strut</u>

Curved tube	d/s	48,3/3,2	mm
Section area	A	453	mm^2
Section modulus	W	4800	mm^3

<u>Tension component</u>

Curved tube	d/s	48,3/3,2	mm
Section area	A	453	mm^2
Section modulus	W	4800	mm^3
Radius of gyration	i	16	mm
Length of a component	a	1500	mm
Slenderness =a/i	λ	94	
Amplification coefficient[1]	∞	1,5	

[1]q.v. tables 7IIa and 7-VII of the Standard CNR 10011

In Annex A there are the actions which act in the strut and in the tension component that provide the maximum stress (reported in II load conditions):

- Strut – N =988 (compression); M = 492800 Nmm

The only assessment which is considered is the resistance one as it is the hardest one.

$$\sigma = \frac{N}{A} + \frac{M_{max}}{W} = \frac{988}{453} + \frac{492800}{4800} = 105\ N/mm^2 \leq 180 = \sigma_{amm}$$

4.7.8 Assessment of 0,30 m adjustable base plate

- Spigot external diameter
- Spigot depth
- Core diameter
- Spigot internal diameter
- Core surface
- Core section modulus
- Spigot minimum length
- Base plate's adjusting maximum height

In conditions of adjusting maximum height, the angle clearance between the base plate and the standards (when the standard internal diameter is ……) is equal to:

In Annex 1 there are the actions which give the maximum stress.(In the plan they are presented with a misalignment; although the assessment is satisfied, for safety reason, the external standards are doubled):

- -N = 11910 N (compression); M = 20060 Nmm

$$\sigma = \frac{N}{A} + \frac{N \cdot h \cdot (\beta_1 + \beta_2) + M}{W \cdot} = \frac{11910}{288} + \frac{11910 \cdot 300 \cdot 0{,}0433 + 20060}{2028} \cong 109\ N/mm^2 < 180\ N/$$

The tests included in the ENPI PTP 161702-161706 of 03/04/74 provide the experience value P_α = 99000 N

$$\mu = \frac{99000}{11910} = 8{,}3 > 2{,}2$$

4.8 Anchorages' assessment

4.8.1 Actions on the anchors

In Annex 1 there are the maximum actions with the following results:

- Floors not related to the gravel guard strut and to the gravel guard's tension component
- Floor related to gravel guard strut
- Floor related to the gravel guard's tension member

NOTE: Scaffold stability is achieved by tying the scaffold to horizontal supporting structures with "special" anchorages placed at intervals of six bays (as reported in Annex A) and capable of resisting to actions with a degree of safety of minimum 2.5. Considering that the working area of these anchorages is equal to 2 floors x 6 ranges (4,3 m^2)and the maximum horizontal strength of the façade brace calculated in the prospectus VD (N = 788 N) is equal to 1 floor x 1 range (0,666 m^2), this anchorage as to support N = (4,3 / 0,666) x 788 =5088 N

4.8.2 Classical anchorages (Nmax < 4480 N)

These anchorages support the scaffolding's perpendicular strengths

4.8.2.1 Loop anchorage

The loop anchorage – made with authorized tubes and joints – needs the assessment of the sliding joint under maximum actions. Considering the reference sliding value, a simple joint of authorized type supports the following maximum action:

- H is the perpendicular strength to the scaffolding
- A2 is the rod's surface of the hook
- W2 is the section modulus of the hook's rod
- d2 is the spacing between the bracket's axis and the hook's rod

4.8.3.2 Anchorage bars with rod ø 20

Rod ø 20 (S235JR)
A_2 = 314 mm^2
W_2 785 mm^2
d_2 = (12+20)/2 = 16 mm

Assessment for the parallel strengths to the scaffolding

$$\sigma_1 = \frac{1}{2}\cdot\frac{H_p}{\cos 45^\circ}\cdot\left[\frac{1}{A_2}+\frac{d_2}{W_2}\right] = \frac{1}{2}\cdot\frac{5088}{\cos 45^\circ}\cdot\left[\frac{1}{314}+\frac{\left(\frac{12+20}{2}\right)}{785}\right] \cong 87\ N/mm^2 < 180\ N/mm^2$$

Assessment for the perpendicular strengths to the scaffolding

$$\sigma_2 = \frac{1}{2}\cdot\frac{H_a}{\cos 45^\circ}\cdot\left[\frac{1}{A_2}+\frac{d_2}{W_2}\right] = \frac{1}{2}\cdot\frac{4480}{\cos 45^\circ}\cdot\left[\frac{1}{314}+\frac{\left(\frac{12+20}{2}\right)}{785}\right] \cong 76\ N/mm^2 < 180\ N/mm^2$$

4.8.3.3 Conclusions

All the assessments are satisfied

CHAPTER V

INSTRUCTIONS FOR SCAFFOLDING LOADING TESTS

GENERAL CONSIDERATIONS

The scaffoldings installed in compliance with the project plan – under the supervision of competent personnel – have been tested through collapse test in compliance with the modalities established by the provisions established by the Ministry of Work and Social Security.
The scaffoldings installed with approved elements, but not in compliance with the project plan, must be tested – under the designer's responsibility – through intensive loading tests in order to assess the presence of a safety factor not under 1.5.
Such tests are not required if the project calculation has been carried out considering the collapse load obtained by the tests on the approved project plans, if the following conditions occur:
a) non-compliance limited to the geometric system of the anchorages, if their different distribution does not affect their distribution density or homogeneity;
b) non-compliance limited to the distance between piers, if the stiffness of the bent plan and of the floor plan is not reduced.

5.1 Testing modalities

The loading tests are carried out on a scaffolding sample installed in compliance with the functional plan designed for the scaffolding to be created, with the following minimal size:

Width

The width of the sample must not be lower than the distance between the anchored bents (at least 4 bents), except if the test is carried out on a sample with the same width of the scaffolding which must be installed.
If the sample is not based on a scaffolding with width greater than the width established in the previous paragraph, it must be extended keeping the same functional plan, so that the external node of the higher deck of the tested sample are anchored.

Height

The height of the sample must not be lower than twice the maximum vertical distance between the anchored decks of the scaffolding.
In any case, the height of the sample is linked to the amount of decks which are necessary to create the loading conditions established in point 5.2.

5.2 Modalities for the creation of the sample

Anchorage

The sample scaffolding must be anchored according to the modalities and the distribution established for the scaffolding which must be installed.
It is allowed, for prevention from sudden collapse, to install additional safety systems, if such systems concern the bents adjacent to the sample used in the loading test and if they are installed without affecting the validity of the results of the loading tests.

Façade and floor stiffness
The sample must be stiffened in the façade and on the floor as established in the design to carry out.

Test loads
Test loads must be indicated by the designer in order to induce tension on the standards of bents which is equivalent to 1.5 times the maximum tension of the most unfavourable loading condition of the calculation report. Test loads corresponding to the weight of the designed structure and to the respective working or no working loads and further vertical loads will be applied to the sample. The same will be done using additional vertical loads to exert tension on the standards which is equivalent to corresponding actions, i.e horizontal, actions (wind etc.) foreseen in the report.
It is permitted to lower additional equivalent loads in order to induce more tension on the standards, deducted moments induced by test loads, in compliance with the assessment criteria of the moments as described in section 7.4.1.1 of the instructions CNR 10011/97.

Testing methods
Tests must be conducted under the designer's responsibility who must avoid any potential risks of accidents. He must check:

a) That the test loads are carried out at an appropriate distance from the personnel by using means such as hydraulic or mechanical tools.
b) That the area surrounding the scaffoldings which can be subject to collapses of the sample is appropriately fenced in order to prevent people from being injured..
c) That the gradual removal of the test load is carried out at an appropriate distance keeping the personnel in a safety area.

5.3 Acceptance Report

The results of test loads must be included in a report, signed by the designer and attached to the calculation report. It must be kept on the building site and must be available to the relevant authorities who request it..

CHAPTER VI

SCAFFOLDING ASSEMBLY, UTILIZATION AND DISASSEMBLY INSTRUCTION

GENERAL CONSIDERATIONS

Beside the scaffolding assembly, utilization and disassembly instructions , also the following provisions laid down by law regulation or administrative action must be respected:

A-PROVISIONS LAID DOWN BY LAW

1-Presidential Decree April 27, 1955, n.147- Specifications for accident prevention
2-Presidential Decree January 7, 1956 n.164-Specifications for accident prevention in buildings
3-Presidential Decree May 24, 1988 n.224-Liability for damage from defect in material
4-Legislative Decree September 1994, n.626-Implementation of the Directives 89/391/EEC, 89/654/ECC, 89/655/ECC, 89/656/ECC, 90/269/ECC, 90/270/ECC, 90/394/ECC, and 90/679/ECC concerning the improvement of workers' safety and health conditions at work.
5-Legislative Decree March 17, 1995 n.115-Products general safety

6-Legislative Decree August 4, 1999 n.359-Implementation of the Directive 95/63/ECC which modifies the Directive 89/655/ECC concerning the minimal safety and health requirements for the use of work equipment by workers
7-Legislative Decree July 8, 2003 n.235-Implementation of the Directive 2001/45/ECC concerning the minimal safety and health requirements for the use of work equipment by workers

B-REGULATORY PROVISIONS

d-Ministerial Decree of the Ministry of Employment and Social Affairs September 2, 1968 (Effectiveness Acknowledgement)
e-Ministerial Decree of the Ministry of Employment and Social Affairs March 23, 1990 n.115 (Effectiveness Acknowledgement)
f-Ministerial Decree of the Ministry of Employment and Social Affairs May 22, 1992 n.466 (Effectiveness Acknowledgement)

C-ADMINISTRATIVE ACTION

- Circular of the Ministry of Employment and Social Affairs n.85/78 of 9/11/78-Authorization for the construction and the use of fix metallic scaffolding
- Circular of the Ministry of Employment and Social Affairs n.22268/PR-7 of 22/5/82-Size Requirements
- Circular of the Ministry of Employment and Social Affairs n.149/85 of 22/11/85-Rules governing the construction and the use of fix metallic scaffolding
- Circular of the Ministry of Employment and Social Affairs n. 44/90 of 15/5/90-Update of the instruction for the compilation of technical reports for fix metallic scaffolding and preassembled frameworks
- Circular of the Ministry of Employment and Social Affairs n.20298/OM-4 of 9/2/95-Use of authorized prefabricated scaffolding parts instead of scaffolding wooden parts
- Circular of the Ministry of Employment and Social Affairs n.22787/OM-4 of 21/1/99-Instruction for the compilation of technical reports, observations and clarification
- Circular of the Ministry of Employment and Social Affairs n.44 of 10/07/00-Verifications and checks, conservation modalities and related documents in Legislative Decree 359/99
    - Circular of the Ministry of Employment and Social Affairs n 46 of 11/07/00 – Safety assessments of metal scaffoldings
    - Circular of the Ministry of Employment and Social Affairs n 20/2003 protocol. 21112/PR/OP/PONT/CIRC of 23/05/03 – Explanations regarding the mixed use of fixed metallic scaffoldings
    - Circular of the Ministry of Employment and Social Affairs n 3 of 08/01/01 Paragraph 2, 4 Legislative Decree No359/99 – Explanations regarding the organization of the scaffoldings' periodic inspections
    - Circular of the Ministry of Employment and Social Affairs n. 20/2003 protocol. 21112/12/PR/OP/PONT/CIRC of 23/05/03 - Explanations regarding the mixed use of fixed metallic scaffoldings
    - Circular of the Ministry of Employment and Social Affairs n. 30/2003 protocol. 21571/PR/OP/PONT/CIRC of 29/09/03 – Paragraph 30 of the Presidential Decree 7 January 1956 No 164 – Explanations regarding the definition of scaffolding's "erector".

6.1 Generalities

6.1.1 Documents to keep on the building site

The construction drawing along with the certification, must be kept on the building site and must be made available to the relevant authorities. The construction drawing must be made in compliance with the project plan provided by the scaffolding manufacturer; every change in the scaffolding which is compatible with the stability requirements can be made only within the framework of the project plan and must be mentioned in the construction drawing.
For scaffoldings not higher than 20 m, the construction drawing must be signed by the building site manager in compliance with the project plans provided by the manufacturer, whereas for the scaffoldings higher than 20m, for scaffoldings which do not comply with the project plan and for special works, a blueprint must be created by an Engineer or by an Architect who is entitled to practice the profession and who is listed in the respective professional register.
It is forbidden to install advertising banners, signs or any panels on the scaffolding unless an assessment is carried out by an engineer or an architect, paying particular attention to the effects on the scaffolding structure, on the anchorages and on the action of the wind in the specific area where the scaffolding is erected.
Such assessment must take into consideration the permeability of the works involved.

6.1.2 Personnel in charge of the assembly

The operations of assembly and disassembly must be carried out by specifically trained personnel; the personnel on the building site must make sure that the scaffolding is assembled perfectly in compliance with the construction drawing and with the following instructions.

6.1.3 Control of the elements

The elements of the scaffolding to be used must be checked in advance in order to put aside those which present deformity, fractures, oxidation and deterioration which may affect the resistance of the scaffolding.

6.1.4 Uniforms of the personnel in charge of the assembly

The personnel in charge of the assembly, of the control and the disassembly of the scaffolding must be provided with the necessary equipment. Furthermore, the must use the following protection tools when working:

-Gloves
-Helmets
-Anti-slip shoes;
-Security belt to be fasten to the structure of the scaffolding;

6.2 Assembly

6.2.1 Scaffolding base plates

The scaffolding base plates must comply with the following instructions:

-the base plates must be sufficiently resistant on the long term; this must be verified before the assembly.

The allocation of the load on the supports must be done through base plates using elements which can allocate the load without exceeding the maximum resistance per unit; such elements must provide enough resistance for the action of the base plates.

6.2.2 Controls during the assembly

During the assembly of the scaffolding the following points must be verified:

- The distance between the scaffolding and the building in order to erect planking next to the building which are in compliance with the construction drawing;
- the verticality of the standards and their axial connection;
- the horizontality of the rails and longitudinal bars;
- the operating order of the connection parts;
- the correct insertion and rotation, wherever required, of the axial connection parts of the standards (pegs);
- The correct collocation of the locking parts of couplings for braces, rails and breastwork longitudinal bars ;
- Compliance with the horizontal and vertical distance as established in the construction drawing;
- The creation of anchorages, façade braces, structural planking by following the progressive assembling of the scaffolding and in compliance with the construction drawing;
- The highest longitudinal bar of the scaffolding in construction must not be 2 m higher than the last set of anchorages.

In case the scaffolding is required to be higher than 2 m beyond the last anchorage, appropriate measures must be taken in order to guarantee the stability of the structure.

6.2.3 Assembly steps

The assembly must be carried out as follows:

- The efficiency of the scaffoldings supports and the resistance of the elements must be checked
- the setting out of the structure is carried out;
- the basic elements are installed; they are made of plates, starting elements and related longitudinal bars and struts.
- after the creation of the first floor, the verticality of the standards is checked as well as their centres between distances;
- the assembly is carried out with particular attention to the creation of anchorages and to the instructions indicated below.

6.2.4 Assembly Instructions

During the assembly of the parts of the scaffolding, the following instructions must be respected:

- the longitudinal bars, braces etc, must be connected to at least two points; the connection part must connect the elements so that their separation can be obtained through intentional intervention, and in order to prevent their separation by accident;
- on every horizontal bay, windbracing connections must be created, in compliance with the plans, assembling prefabricated decks;

- longitudinal connections (façade) must be created using longitudinal bars and braces, with particular care to anchorages to prevent accidental uncoupling (in compliance with project plans in chapter 7);
- the standards of the top frameworks must be 1,20 higher than the last deck and the eaves;
- anchorages must be created on existing structures, in compliance with the plans in Annex "A" of Chapter 7. Anchorages must be placed in compliance with the indications in the plans;
- the laying underground of a part of the scaffolding for the creation of vehicle entrances or for other reasons is permitted when it is carried out in compliance with the indications in the plans;
- if it is not possible to access the decks of the scaffolding directly from the work, the appropriate stairs must be used, in compliance with art.8 of the Presidential Decree 164, paragraph 6 (see also Annex "A");
- in case it is necessary to use parts of the scaffolding like tubes and joints for the levelling of the laying plan, or particular starting levels or connections, gravel guards, breastworks, etc. it is necessary:

c) that the parts of the scaffolding like tubes and joints are included in a single Ministerial Authorization,
d) that the plans stated in the Ministerial Authorization are scrupulously respected, both for the parts with tubes and joints, and for the amount and the position of the parts used, as well as for the constraint methods (anchorages).
e) That the coupling of the joints is carried out with the moment indicated by the manufacturer;
f) That it is possible to connect tube elements joints and frame joints, without following instructions which differ from those provided in the authorizations;
g) It is advisable, wherever possible, to stagger the connections among standards in the façade plane for the contiguous erections and in the bent plane.

6.3 Use

6.3.1 Scaffoldings floor

The scaffoldings floor to be used in the building activities must:

- have planking assembled in compliance with the project plan;
- be made by boards close to each other and close to the building under construction: the distance allowed is 20 cm;
- be used only if the distance does not exceeds 2 m from the highest anchorages;
- be provided with clear and visible instructions concerning the maximum loading conditions;
- be provided with a breastwork longitudinal bar on the external façades made of an upper longitudinal bar and a lower longitudinal bar and of the toe board, in compliance with the project plans and with the following points:

a) the upper edge of the highest longitudinal bars must be distant not less that 1 m from the planking;
b) the toe board, located with the lower edge touching the planking, must be higher than 20cm;
c) the distance between the lower longitudinal bar and the toe board and between upper longitudinal bar and lower longitudinal bar must not exceed 60 cm;

- be provided with a gravel guard which is able to intercept the fall of materials. The gravel guard must be installed on all planking and must protrude for at least 150 cm horizontally.

The use of planking without gravel guard is allowed only if the area in front the scaffolding for at list 150 cm from the external standard.

6.3.2 Access

Access to the scaffolding floors can be granted through a stairs tower, built with scaffoldings elements in compliance with paragraph 6 of article 8 of the Presidential Decree 7 January 1956 No164 or through the building under construction.

6.3.3 Snow storms

When the scaffolding must be used for heights higher than those defined in chapter IV, with regard to the water level, it is necessary to keep on the working site a verification calculation drafted by an Engineer or an Architect who is entitled to practice the profession and who is listed in the respective professional register.

For heights lower than those defined in Chapter IV, with regard to the water level, it is necessary, considering the area and the height, to follow the plans indicated in the annex to chapter 7.

6.3.4 Checks

6.3.4.1 Periodic and special checks

The building site manager must check, at periodic intervals (at least every three months) or after bad weather or interruptions of the works for long periods:

- the conditions of the supports;
- the verticality of the standards;
- the efficiency of the connections;
- the efficiency of anchorages and braces, with particular attention to the replacement and the reinforcement of defective elements.

6.3.4.2 Daily checks

The following items must be checked by competent personnel:

- the regularity of decks and systems for the prevention of falls of workers and materials;
- the presence of structural included in the plan;
- the respect of the overload limits established and the respect of the amount of load-bearing decks and of decks without load included in the plan;
- the respect of the prohibition to go up and down the standards;
- the respect of the regulations and of the type of anchorages in compliance with the plans;
- the efficiency of the devices and the earthing of the scaffolding.

6.3.5 Systems and electric devices

The systems and the electric devices which concern the scaffolding must be realized in a suitable manner for the working conditions (humidity, rain, etc.) and must be installed in appropriate ways to prevent contact voltage on the structures.

6.4 Dismantling

During dismantling operations the following precautionary measures must be respected:

- the dismantling of the scaffolding must be gradual;

GOFFI INDUSTRIE EDILIZIA srl

AUTHORIZATION FOR THE CONSTRUCTION AND THE USE OF METALLIC SCAFFOLDING MADE OF PREASSEMBLED FRAMEWORKS FOR CONSTRUCTION WORKS

ANNEX A

MINISTRY OF WORK AND SOCIAL POLICIES
Head Management for the Preservation of Work Conditions
Section VII – Work Security and Safety
Annex n.1 of the Authorization included in
protocol letter nr. 2693 /PR/OP/PONT/A of May 17, 2004

Scaffolding of portal 105 type preassembled frameworks with bushes

GIE-180

ANNEX A: LIST	GIE-180		
ITEM	Weight [daN]	Weight [daN]	TABLE Nr.
General indications	-	-	3
Table 1 A, 2 A (size and tolerance, mechanical characteristics of the tubes)	-	-	4
Table 1 B, 2 B (size and tolerance, mechanical characteristics of rounds, plates and profiles)	-	-	5
Framework	20.1	20.5	6
Framework details	-	-	7
Façade longitudinal bars	2.75	2.85	8
Façade braces	3.5	3.6	
Details of pins for longitudinal bars/braces	-	-	9
Table 0,49x1,8	-	15.0	10
Table 0,49x1,8 (details tox points)	-	-	11
Table 0,49x1,8 (details)	-	-	12
Table 0,49x1,8 (sections)	-	-	13
Table 0,49x1,8 (header)	-	-	14
Adjustable terminal board	2.0	2.1	15
Scaffolding peg	-	0.135	16
Anchorage bar 330	1.5	-	17
Anchorage bar 1400	5	-	
Gravel guards	-	-	18
Foot stops, planks, header longitudinal bars	-	-	19
Foot stops, planks, façade longitudinal bars	-	-	20
Foot stops and planks	-	-	21
Parts for the use of terminal boards	-	-	22
Anchorages	-	-	23
Overall project plan	-	-	24
Limit conditions for the utilization	-	-	25

GENERAL INDICATIONS

LONGITUDINAL DIMENSIONAL TOLERANCE
(UNI EN 22768-1)

IF NOT DIFFERENTLY INDICATED ON THE DRAWINGS

From (mm)	3	6.01	30.01	120.01	400.01	1000.01	2000.01	4000.01
To (mm)	6	30	120	400	1000	2000	4000	8000
Tol. (mm)	+ - 0.1	+ - 0.2	+ - 0.3	+ - 0.5	+ - 0.8	+ - 1.2	+ - 2.0	+ - 3.0

WEIGHT OF THE ELEMENTS:

WHERE NOT DIFFERENTLY INDICATED,
THE TOLERANCE OF THE WEIGHT OF A
MINIMUM BATCH OF 1000 ITEMS IS + - 5%

ELEMENTS PROTECTION:
THE ITEMS HAVE A SUPERFICIAL COVERING
AGAINST CORROSION, THROUGH PAINTING OR
HOT GALVANIC ZINC COATING

MARK:
“GIE”: ETCHED AND IN RELIEF

TOLERANCE ON HOLES:
IF NOT DIFFERENTLY INDICATED
ON THE DRAWINGS,
THE TOLERANCE ON HOLES IS + - 0.4

TAB. 1A - SIZE OF THE TUBES WITH CIRCULAR SECTION												
			EXTERNAL DIAMETER mm				THICKNESS					
ORD. Nr.	Reference Reg.	Nom. Ø	TOL.		Ø		Nom. Thick.	TOL.		Thickness		USE
	Circ 44/90		+	-	MAX.	MIN.		+	+	MAX.	MIN.	
1	UNI EN 10219-2	48,3	0.5	0.5	48.8	47.8	2.9	10	5	3.19	2.755	Standards and framework longitudinal bar
2	UNI EN 10219-2	48,3	0.5	0.5	48.8	47.8	3.2	10	5	3.52	3.04	Tube for anchorage bar
3	UNI EN 10219-2	40	0.5	0.5	40.5	39.5	3.4	10	5	3.74	3.23	Peg
4	UNI EN 10219-2	26,9	0.5	0.5	27.4	26.4	2.3	10	5	2.53	2.185	Framework, longitudinal bars, braces, façade, framework bushes
5	UNI EN 10219-2	40	0.5	0.5	40.5	39.5	6.2	10	5	6.82	5.89	Tube for adjustable terminal board

TABLE 2A – MECHANICAL FEATURES OF THE TUBES								
Nr.	Profiles	SIZE (mm)	NORMS	RESISTANCE FEATURES				
				MATERIAL	fy(N/mm²)	fy(N/mm²)	All % 5.65	All % 80 mm
1	Tube	48.3x2.9	UNI EN 10219-1	S235JRH	> = 235	360-510	-	> = 17
2	Tube	48.3x3.2	UNI EN 10219-1	S235JRH	> = 235	330-470	> = 17	-
3	Tube	40x3.4	UNI EN 10219-1	S235JRH	> = 235	330-470	> = 17	-
4	Tube	26.9x2.3	UNI EN 10219-1	S235JRH	> = 235	360-510	-	> = 17
5	Tube	40x6.2	UNI EN 10219-1	S235JRH	> = 235	340-470	> = 17	-

TABLE 1 B – SIZE OF PROFILES – PLATES - ROUNDS													
Nr.	PROFILES	DIAMETER/WIDTH (mm)					THICKNESS (mm)					USE	
		Nom.	Tolerance		Size		Nom.	Tolerance		Size			
			+	-	Max.	Min.		+	-	Max.	Min.		
1	plate						1	0.08	0.08	1.08	0.92	Table cover	UNI EN 10143
2	plate						3	0.17	0.17	3.17	2.83	Table head	UNI EN 10143
3	plate						6	0.29	0.29	6.29	5.71	Basic plate for adjustable terminal board	UNI EN 10051
4	round	8	0.4	0.4	8.4	7.6						Table safety system	EU 60
5	round	10	0.4	0.4	10.4	9.6						Scaffolding peg	EU 60
6	round	18	0.5	0.5	18.5	17.5						Peg for longitudinal bars and braces	EU 60
7	round	20	0.5	0.5	20.5	19.5						Hook for anchorage bar	EU 60

TABLE 2 B – MECHANICAL FEATURES OF PROFILES – PLATES - ROUNDS								
Nr.	Profiles	Size (mm)	NORMS	RESISTANCE				
				Material	fy0.2(N/mm²)	ft(N/mm²)		
1	Plate	1	UNI EN 10147	S250GD	> = 250	>=330	-	>=19
2	Plate	3	UNI EN 10147	S250GD	> = 250	>=330	-	>=19
3	Plate	6	UNI EN 10025	S235JR	> = 250	340-470	>=26	-
4	Rounds	8	UNI EN 10025	S235JR	> = 250	340-470	>=26	-
5	Rounds	10	UNI EN 10025	S235JR	> = 250	340-470	>=26	-
6	Rounds	18	UNI EN 10025	S235JR	> = 250	340-470	>=26	-

7	Rounds	20	UNI EN 10025	S235JR	> = 250	340-470	>=26	-

Tav.6

MARCHIO INCISO	ETCHED MARK
PER I DETTAGLI VEDI TAV.7	FOR DETAILS SEE TAB.7
BOCCOLA ORIZZONTALE	HORIZONTAL BUSH
LAVORAZIONE DELLO SPINOTTO	PEG PROCESSING
BOCCOLA VERTICALE	VERTICAL BUSH
TUBO	TUBE
DESCRIZIONE	DESCRIPTION
DISEGNO/MASSA	DRAWING/MASS
DESCRIZIONE: TELAIO	FRAMEWORK: DESCRIPTION
MATERIALE	MATERIAL
SISTEMA DI PONTEGGI	SCAFFOLDING
DISEGNATO	DRAWINGS BY
DATA	DATE
DISEGNO: TAV 6	DRAWING: TAB.6

Tav. 7

Dett.C	Detail C
Dett.B	Detail B
Dett.A	Detail A
Sez.C-C	Section C-C
DESCRIZIONE	Description
MATERIALE	MATERIAL
SISTEMA DI PONTEGGI	SCAFFOLDING
DISEGNATO	DRAWINGS BY
DATA	DATE
DISEGNO:TAV.7	DRAWING: TAB.7

Tav. 8

N.4 AGGRAFFATURE DEL TUBO SULLA SPINA	Nr.4 FOLDED SEAMS OF THE TUBE ON THE PEG
MARCHIO GIE ESEGUITO PER INCISIONE CON PROFONDITA’ di 0.5 mm	GIE MARK OBTAINED THROUGH INCISION WITH DEPTH 0.5 mm
DIAGONALE DI FACCIATA	FAÇADE BRACES
CORRENTE DI FACCIATA	FAÇADE LONGITUDINAL BARS
TUBO	TUBE
SPINA - DA RIBADIRE -	PEG - TO RIVET -
CAMPANINA BASCULANTE	TILTING BELL HOUSING
SPINA PER AGGRAFFATURA	PEG FOR FOLDED SEAM
VEDI DETTAGLI TAV.9	SEE DETAILS TAB.9
DESCRIZIONE: CORRENTE DIAGONALE 1.8 M	DESCRIPTION: DIAGONAL LONGITUDINAL BAR 1.8 M

Tav.9

CAMPANINA BASCULANTE	TILTING BELL HOUSING

Tav. 10

Anno di produzione in rilievo	Relief production year
Marchio in rilievo	Relief mark
Punti tox	Tox points
Elemento di sicurezza	Safety element
10 fori per scarico acqua	10 holes for water discharge
203 bugne antiscivolo	203 slide-safe indentations
18 bugne antiscivolo	18 slide-safe indentations
Sez. A-A e sez- II-II vedi tav. 12	Section A –A and section II –II see table 12
Manto spessore 1	Cover thickness 1
Profilo a Ω spessore 1	Ω Profile thickness 1
Testate in lamiera sagomata	Profiled plate headpiece
Descrizione	Description

Tav.11

Anno di produzione in rilievo	Relief production year
Marchio in rilievo	Relief mark
Punti tox	Tox points
Elemento di sicurezza	Safety element
10 fori per scarico acqua	10 holes for water discharge
203 bugne antiscivolo	203 slide-safe indentations
18 bugne antiscivolo	18 slide-safe indentations
Sez. A-A e sez- II-II vedi tav. 12	Section A –A and section II –II see table 12
Manto spessore 1	Cover thickness 1
Profilo a Ω spessore 1	Ω Profile thickness 1
Testate in lamiera sagomata	Profiled plate headpiece
Descrizione	Description

Tav. 12

Dett. E	Detail E
Dett. F	Detail F
Dett. H	Detail H
Sez. A-A	Section A-A
Per i dettagli E, F, H vedi tav. 13	For details E, F, H see tab 13
Per la legenda vedi tav.10-11	For the legend see tab 10-11
Quota manto	Cover height
Quota estradosso traverso	Strut extrados height
Quota estradosso bugne	Indentations extrados height
Quota estradosso testata	Headpiece extrados height
Elemento di sicurezza	Safety element
Punti tox	Tox points

Tav. 13

Dettaglio H	Detail H
Dettaglio E	Detail E
Bugne per deflusso acqua	Indentations for water downflow
Rinforzo a OMEGA	OMEGA reinforcement
Dettaglio F bugne antiscivolo	Detail F slide-safe indentations
Quota manto	Cover height

Quota estradosso traverso	Strut extrados height
Quota estradosso bugne	Indentations extrados height
Quota estradosso testata	Headpiece extrados height

Tav. 14

Deformazione causa nervature	Deformation due to rib
Sez. A-A	Section A-A
Dett. E (bugna)	Detail E indentation
Sez. B-B	Section B-B
Sez. C-C	Section C-C
Dett. E (bugna)	Detail E indentation
Dett. F	Detail F
Sez. D-D	Section D-D
Sez. G-G	Section G-G
Sez. H-H	Section H-H
Quota manto	Cover height
Quota estradosso traverso	Strut extrados height
Quota estradosso bugne	Indentations extrados height
Quota estradosso testata	Headpiece extrados height

Tav. 15

Interruzione del filetto con punto di saldatura	Interruption of the thread through welding
Marchio inciso	Etched mark
Dettaglio filetto (filetto ottenuto per asportazione di materiale)	Thread detail (thread obtained through removal of material)
Ghiera	Ring nut
La regolazione in altezza fino al massimo previsto è consentita solo nell'ambito degli schemi autorizzati	The height adjustment up to the estimated limit is only allowed within the authorized plans
Piastra di base	Basic plate
Boccola	Bush
Stelo	rod

Tav. 16

Marchio GIE inciso	GIE etched mark

Tav. 17

Marchio GIE inciso	GIE etched mark
SEZIONE A-A	Section A-A
Tubo	Tube
Tondo	Rounds

Tav. 18

Tavolo in legno 20 x 5	Wooden plank 20 x 5
Giunto di tipo autorizzato	Authorized connection
Giunto di tipo autorizzato	Authorized connection
Telaio	Framework
Ancoraggio	Anchorage
Tavole metalliche obbligatorie	Compulsory metallic planks
Elemento di raccordo tra parasassi e piano di	Connection element between gravel guards and

lavoro(Tavola in legno 20 x 5)	working floor (Wooden plank 20 x 5)
Opera Servita	Building
Tavole metalliche obbligatorie	Compulsory metallic planks
Diagonale di facciata	Façade brace
Giunto di tipo autorizzato	Authorized connections
Ancoraggio	Anchorage
Parasassi e giunti di tipo Autorizzato appartenenti ad unica Autorizzazione Ministeriale	Gravel guards and authorized connections included in a single Ministerial Authorization
Distanza tra filo impalcato e opera servita	Distance between scaffolding edge and building

Tav 19

Vedi tav. 14 Quota estradosso traverso	See table 14 Strut extrados height
Quota estradosso testata	Headpiece extrados height
Dispositivo di bloccaggio del fermapiede	Toe board blocking system
Tavola fermapiede in legno	Wooden toe board
Correnti di parapetto in tubi e giunti	Breastwork longitudinal bars made of tubes and joints
Ancoraggio	Anchorage
Tavola metallica obbligatoria	Compulsory metallic plank
Diagonale di facciata	Façade brace
Opera Servita	Building under construction
Dispositivo di bloccaggio del fermapiede	Toe board blocking system
Tubi e giunti di tipo Autorizzato appartenenti ad unica Autorizzazione	Tubes and authorized connections included in a single Authorization
Diagonale di facciata	Façade brace

Tav. 20

Tavola metallica	Metallic board
Diagonale di facciata	Façade brace
Telaio	Framework
Correnti di parapetto	Breastwork longitudinal bars
Quota estradosso traverso	Strut extrados height
Quota estradosso bugne	Indentations extrados height
Vedi Tav 14	See table 14
Tavola fermapiede in legno	Wooden toe board

Tav. 21

Opera servita	Building under construction
Telaio	Framework
Fermapiede in legno	Wooden toe board
Distanza tra opera servita e filo impalcato	Distance between building under construction and scaffolding edge

Tav. 22

Basette regolabili	Adjustable terminal boards
Distanza tra opera servita e filo impalcato	Distance between building under construction and scaffolding edge
Fissaggio della piastra della basetta agli	Fastening of the plate of the terminal board to

elementi di ripartizione	the separation elements
Elemento di ripartizione	Separation element
Quota estradosso traverso Quota estradosso bugne	Strut extrados height Indentations extrados height
Per 3200 mm le piastre delle basette vanno fissate agli elementi di ripartizione, ovvero il telaio viene chiuso alla base con stucco in tubo e giunti appartenenti ad unica Autorizzazione e comunque deve essere ancorato il primo piano	For 3200 mm the plates of the terminal boards must be fastened to the separation elements, the framework is closed at the bottom with putty and joints included in a single Authorization; the first floor must be anchored
Per 3200 mm il numero massimo degli impalcati sulla stessa verticale è pari a 9 piani con h max 20 m	For 3200 mm the maximum amount of decks on the same vertical line is 9 floors with maximum height 20 m
H = altezza massima del ponteggio dal piano di campagna all'estradosso bugne dell'ultimo piano praticabile	H = maximum height of the scaffolding from the lower level to the indentation extrados of the last viable floor
N.B. tavole metalliche obbligatorie in tutti i piani	N.B. metallic boards must be present on every floor
L'elemento di ripartizione di piede deve avere dimensioni e caratteristiche adeguate ai carichi da trasmettere alla consistenza dei piani di posa ed interasse almeno due montanti contigui (vedi art. 5 lett. C D.M. 2/9/68)	The end separation element must have appropriate size and characteristics for the loads which must be supported by the substructures and a distance between centres of at least two contiguous uprights (see art. 5 Ministerial Decree of 2/9/68)

Tav. 23

Montante interno	Inside standard
telaio	Frame
Tubi e giunti di tipo autorizzato appartenenti ad un'unica autorizzazione	Tubes and authorized connections included in a single authorization
Traverso	Strut
Ancoraggio a cravatta	Loop Anchorage
Ancoraggio ad anello	Ring anchorage
Ancoraggio con tubi 48,3x3,2	Tube anchorage
Ancoraggio con barra con gancio	Bar anchorage with hook
Ancoraggio a "V" con barre con gancio	V anchorage with hook
Distanza tra opera servita e filo impalcato	Distance between scaffolding edge and building
Tassello	Nog
Elemento di ripartizione	Separation element
	The system's retention performances must be tested experimentally on the assembling site or (only for the nogs) judged according to the experimental data of tests carried out by other building companies. Besides, they must present a degree of safety not inferior to 2.5 comparing to the actions needed for the anchorage.

Tav.24

Ultimo piano praticabile	Last accessible floor
H = altezza misurata dal piano di appoggio dell'elemento di ripartizione dei carichi dei montanti, all'estradosso dell'ultimo impalcato	Height measured from the base of the separation element of loads on standards, at the extrados of the last plank.

Tavola fermapiede di facciata in legno	Façade wooden toe board
Diagonali di facciata	Façade braces
Correnti di parapetto	Breastwork longitudinal bars
Parapetto di testata in tubo e giunto di tipo autorizzato appartenenti ad unica autorizzazione	Tube head rail and authorized connections included in a single Authorization
Tavola fermapiede di testata in legno	Wooden head toe board
Tavole metalliche obbligatorie a tutti i piani	Compulsory metallic planks on all floors
Distanza fra opera servita e filo impalcato	Distance between scaffolding edge and building
Per l'impiego delle basette regolabili vedi TAV. 22	To use adjustable terminal boards please see TAV.22
Ancoraggi normali	Normal anchorage
Ancoraggi speciali	Special anchorage

TAV 25

CONDITIONS AND LIMITS OF USE AND INSTRUCTIONS FOR ALL PROJECT PLANS

1. MAXIMUM HEIGHT OF HIGHEST PLANK: 20 m

2. MAXIMUM NUMBER OF METALLIC PLANKS WHICH CAN BE ASSEMBLED (*): 10

3. MAXIMUM WORKING LOAD

SCAFFOLDINGS FOR BUILDING PURPOSES:	Working floor 300daN/m^2
	-1 working floor 150 daN/m
SCAFFOLDINGS FOR MAINTENANCE PURPOSED;	- 3 working floor 150 daN/m^2

4. MAXIMUM HEIGHTS ABOVE THE SEA LEVEL, in different geographic areas, where it is possible to use the scaffoldings WITHOUT CARRYING OUT CALCULATIONS

AREA	REGIONS	HEIGHT above sea level
I	Valle d'Aosta, Piemonte, Lombardia, Trentino Alto Adige, Emilia Romagna, Friuli Venezia Giulia, Veneto, Abruzzo, Molise, Marche.	500 m
IH	Liguria, Toscana, Umbria, Lazio.	790 m
	Campania, Basilicata, Calabria, Puglia, Sardegna, Sicilia,	920 m

5. AZIONI MASSIME DA TRASMETTERE AL PIANO D'APPOGGIO;

PLANS	Inside standard [daN] Exercise	Inside standard [daN] no exercise	Outside standard exrcise [daN]	Outside standard [daN] no exercise
- Plan with compulsory metallic planks on all floors	801	746	1040	1191

6. MAXIMUM ACTIONS ON THE ANCHORAGES (PERPENDICULAR TO THE FAÇADE)

Plan with compulsory metallic planks on all floors

- connection floor with gravel guard: 448 daN (435 daN)
- higher floor: 339 daN (+34 daN)
- different floors: 400

AS FOR PERPENDICULAR ACTIONS TO THE FAÇADE of the building under construction anchorages can be used, such as ring and loop anchorages also with nogs (es. chemical). For the type of anchorage carried out it is required that the system anchorage-building under construction guaranteed a degree of safety not inferior to 2,5 comparing to the action on the anchorage. such safety degree must be evident in the cortication of tests implemented by the manufacturer on the retention system and in experimental tests.

AS FOR THE ACTIONS PARALLEL TO THE FAÇADE of the building under construction, on the anchored floors, for at least every six bents, anchorages guaranteed a degree of safety not inferior to 2,5 to actions 509 daN parallel to the façade plan must be realized. Such anchorages must be used employing L systems and equivalent systems.

7. ACCESS TO THE SCAFFOLDINGS: access to the floors will be created by assembling stairs tower built with elements of the scaffolding authorized in compliance with paragraph 6 of art.8, D.P.R. 7/1/1956 n° 164,

(*) it is compulsory to use metallic planks on all floors

INSTRUCTIONS FOR METAL PREFABRICATED SCAFFOLDINGS OF MORE THAN 20 METRES IN HEIGHT AND FOR SIMILAR TEMPORARY COMPLEX METAL FRAMEWORKS.

ITALIAN MINISTRY OF EMPLOYMENT AND SOCIAL AFFAIRS

1) These instructions sets out the requirements and methods of dimensioning and loading for metal scaffoldings of over 20 metres in height and for other temporary metal or complex frameworks. On the contrary standards for 20 metres height scaffoldings are applied to 'classic' scaffoldings and to other temporary complex frameworks, erected in accordance with the project plans subjected to global laboratory tests.
2) DEAD LOADS

They are calculated considering the average values regarding the weight of the scaffolding's components which are established during the planning stage, as well as the weight of additional supporting structures for the erection and use of scaffolding. For scaffoldings used for building construction, in particular, it is important to include the weight of a certain number N of components (scaffolds, lower structures, gravel guards), calculated with the following formula:

$$N > 3 + H/30$$

where H (> 20) is the scaffolding height. Where the plan requires a lower number of scaffolds, the scaffold designer can alter the N value and provide the working load limit of scaffolding and of framework.

3) LIVE LOADS

They should be calculated in accordance with the standards CNR 10027/85

ILLEGGIBILE

Classes of scaffolds	Kind of work	Uniformly distributed load
1	Inspection works Working load- additional to the estimated actions for live loads- for scaffoldings used for tunnels excavation	0,75

2	Maintaining works (painting, cleaning, finishing, repairing ecc.) without deposit of materials except the necessary ones.	1,50
3	Maintaining works with the deposit of materials necessary for the daily work.	2,00
4	Construction works (brickwork, concrete casting ecc.)	3,00
5	Temporary deposit of materials (loading platforms).	4,50
6	Heavy walling works- routes for light vehicles.	6,00

Scaffolds

Scaffolds should comply with the working loads indicated in prospectus 3 B

Uniformly distributed load

Scaffolds should comply with uniformly distributed loads indicated in column 2.

Load over a 500mm x 500mm area

Scaffolds should comply with the load gathered in over a 500mm x 500mm area, indicated in column of prospectus 3 B. The load position should be designed for the most adverse conditions. When the width of the scaffolding structure is lower than 500 mm, the load has to be reduced in proportion to the width, to a minimum of 1,5 KN.

Load over a 200mm x 200mm area

Each scaffold should comply with a load of 1 KN uniformly distributed over a 200mm x 200mm area and it should be designed for the most adverse conditions.

Load over a partial area

Each scaffold belonging to classes 4, 5 and 6 should comply with the load, indicated in column 4 of prospectus 3 B designed for a rectangular area (partial area), that corresponds to the fraction indicated in column 6 of prospectus 3 B.

Dimensions and position of this area should be designed for the most adverse conditions.

3.6 Parapets

In addition to the values regarding the thrusts on parapets under the standards CNR 10027/85, parapets of any length, used as fall protections for employees working on scaffolds, should comply with the following conditions:

- elastic deflection of maximum 5 mm under a controlled load of 0,3 KN;

- absence of any breaking or deflection higher than 200 mm under a gathered load of 1,25 KN;

PROSPECTUS 3 B Working loads for scaffolding use for construction

1	2	3	4	5	6
Class	Uniformly distributed load	Load gathered over a 500mm x 500mm area	Load gathered over a 200mm x 200mm area	Load over a partial area	
1*	0,75	1,50	1,00		non applicable
2	1,50	1,50	1,00		non applicable
3	2,00	1,50	1,00		non applicable
4	3,00	3,00	1,00	5,00	0,4 - A
5	4,50	3,00	1,00	7,5	0,4 - A
6	5,00	3,00	1,00	10,00	0,5 - A

* Each component should have a capability not lower than those ones required for a scaffold belonging to class 2.

4. Assessment evaluation

4.1. Global stability evaluation

stability evaluation should comply with effects belonging to II order, directly using an elastic analysis of II order and indirectly referring to an elastic analysis of I order- with a length which corresponds to the instability of an adjustable joints system – and adopting a multiplication factor in the members……. Obtained through the following formula:

where:

a) γ is the coefficient of safety

   γ = 1,0 for the assessments of the limit states

   γ = 1,5 for the assessments through the method of allowable tensions, according to the I loading condition.

   γ = 1,33 for the assessments through the method of allowable tensions, according to the II loading condition.

b) N is the axial load of the member compression

c) Ncrit is the critical load calculated through the…… that refers to the structure member in relation with its effective slenderness.

When the member's slenderness has not been established through the experimental system it is necessary to carry out the assessments indicated in paragraph 7.5.2 of the standard CNR 10011/85.
In presence of joints used to join the different elements, it is necessary to verify their effective rigidity and to carry out the sliding assessment in order to guarantee a safety degree of at least 1,5 in comparison with the fractile 5% that results from the sliding tests.

4.2. Stability and resistance local assessments

The evaluation assessment should include the loading conditions for each one of the components (standards, struts, façade braces, braces in pan, parapets, joints, scaffolds, brackets, working platform, gravel guards, cantilevers, anchorages, sharing elements of the base plates).
The assessment of all these components are not required exclusively when the stability and resistance results are verified in the certification for the scaffolding erection and use in the most adverse loading conditions.

5. Acceptance and loading tests

Scaffoldings and other temporary complex frameworks erected in accordance with the project plans subjected to global laboratory tests, do not require the static acceptance.
On the contrary, scaffoldings and other temporary complex frameworks erected in accordance with no approved plans require the static acceptance under the Standards CNR 10011/85 and 10027/85.
The results of the loading tests should be annexed to the acceptance report which should be at workplace together with evaluation reporting case of a security service's control.