Hilam

Productos Hilam Estándar

Tablas de Cálculo

Capítulo 1

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Qué es Hilam Estándar

Hilam Estándar es una línea de productos de ingeniería para la construcción, conformada por elementos de madera laminada de sección estándar que se complementa con otros productos de madera y tableros de Arauco. Además, se puede usar en estructuras mixtas, combinado con otros materiales como hormigón armado y acero.
Hilam Estándar es indicado para usos como pilares, vigas, pies derechos, dinteles, tapacanes, sistemas de piso, techo y escaleras en aplicaciones residenciales, de decoración e industriales.

Características Técnicas de Hilam

- Hilam está fabricado con madera seca de pino radiata seleccionada por su resistencia y apariencia, unida mediante finger-joint, formando láminas que luego se encolan por sus caras.
- En la fabricación de Hilam se usa un adhesivos estructurales para exterior (resorcinol-fenol-formaldehído o melamina-urea-formaldehído).
- Hilam es certificado por un organismo externo (Fundación Chile), el cual verifica el cumplimiento de las normas chilenas NCh2148 y NCh2150.

Ventajas del Producto

- Versatilidad de diseño por la variedad de perfiles y largos de hasta 30 m.
- Tiene la belleza, calidez y naturalidad de la madera.
- Compatibilidad con otros materiales, puede usarse en estructuras mixtas.
- Fácil de montar, son elementos livianos y simples de unir.
- Se puede terminar con tintes y barnices en una variedad de tonalidades.
- Alta resistencia en relación a su peso.
- Resistencia a la corrosión. La madera es resistente a los ambientes salinos y a la acción de gases corrosivos. Es especialmente importante en el caso de sectores costeros, piscinas temperadas o de actividad industrial.
- Resistencia al fuego: la madera en grandes secciones es muy resistente al fuego. Tiene una tasa de carbonización de 0,7 mm/min. Mantiene sus propiedades resistentes, dado que la temperatura se mantiene baja al interior del elemento.
- Bajo coeficiente de dilatación por temperatura.
- Recurso renovable, el pino radiata proviene de plantaciones. Además los elementos pueden ser reutilizados.

Dimensiones de Hilam Estándar

Las dimensiones y tolerancias de Hilam Estándar (espesor y ancho) se entregan en la tabla 1. Aunque es posible fabricar elementos de hasta 30 m de largo, en la práctica el largo está limitado por el transporte y manipulación de las piezas.

Elementos Curvos

Los elementos Hilam curvos, tienen las mismas secciones que los elementos rectos.
Es necesario considerar:

- El radio de curvatura condiciona el espesor de las láminas que conforman Hilam.

  - espesor lámina = radio curvatura x 0,06
    se sugiere radios superiores a 3m.

- Transporte: el desarrollo del elemento curvo tiene que ser tal que quepa en una rampla, que tiene 2,44 m de ancho.

Propiedades Estáticas

En la tabla 2 se presentan las propiedades estáticas para el diseño, de los elementos de Hilam Estándar.

Luces Admisibles para Techos y Pisos

Para facilitar la decisión respecto a las capacidades de los elementos, se presentan tablas de luces admisibles y alturas de viga conforme a estados de carga en aplicaciones de pisos y techos. Los cálculos se basan en los criterios de las normas chilenas vigentes. Los valores son los máximos admisibles y suponen un adecuado sistema de herrajes, arriostramiento, cadeneteo para evitar el volcamiento de las vigas, fijaciones y el respeto de las condiciones de peso propio y sobrecarga de las normas.

Luces Admisibles para Envigados de Piso (tabla 3)

Estas consideran los siguientes supuestos:

- Piso liviano: peso propio de 60 kgf/m^2, que corresponde a un revestimiento de Terciado Estructural o entablado.
- Piso acústico: Peso propio de 150 kgf/m^2, que corresponde a un sistema de piso con Terciado Estructural y una sobrelosa de hormigón armado de 5 cm.
- Sobrecarga de servicio de 150 kgf/m^2.
- Las deformaciones máximas admisibles consideradas en el cálculo es L/300 para la carga total.

Luces Admisibles para Envigados para Techos (tablas 4,5,6 7,8 y 9)

- Pendientes de 5%, 15%, 30%, 45%, 60% y 100%.
- Pesos de techo: 15 kgf/m^2, 30 kgf/m^2, 60 kgf/m^2 y 120 kgf/m^2.
- Las deformaciones máximas admisibles consideradas en el cálculo es L/200 para la carga total y L/360 para la sobrecarga de servicio.

Las soluciones presentadas incorporan en algunos casos, simplificaciones conservadoras, como es la consideración de un área tributaria no superior a 20 m2 en la estimación de la sobrecarga de servicio de la techumbre y la aplicación de la tensión admisible de flexión mínima permitida para vigas de madera laminada de Pino Radiata en la norma NCh2165.

Alturas de viga requeridas para densidades de carga y luces establecidas, en aplicaciones de Pisos y Techos horizontales (tabla 10)

Densidad de carga. Se obtiene multiplicando la carga a que está sometida la estructura (kgf/m^2 o N/m^2) por el distanciamiento entre elementos (m).
A mayor distanciamiento, mayor densidad de carga.

Instalación

- Si se requieren herrajes metálicos, usar preferentemente elementos de fierro galvanizado, para evitar manchas en la madera por el óxido.
- Hacer los cortes, perforaciones y rebajes con herramientas adecuadas, para no dañar las piezas de madera.

Recomendaciones para la Terminación

- Si el producto queda a la vista, es necesario que el montaje se haga cuidando de no ensuciar ni dañar los elementos.
- En aplicaciones interiores se puede usar cualquier barniz para madera. La decisión dependerá del brillo, tinte y mantención que requerirá la aplicación en el tiempo. Si parte de la estructura recibirá sol, es necesario usar un producto con filtro UV, de modo que no se produzcan cambios en la tonalidad de la madera.
- En aplicaciones exteriores es recomendable aplicar productos que prueben un alto desempeño: Protectores o Stains no formadores de película,idealmente con tintes o Pintura. Solicitar a los fabricantes la garantía que ofrecen para sus recubrimientos, en la aplicación específica donde será usado Hilam.
- La aplicación de los sistemas de acabado debe hacerse respetando las indicaciones de los fabricantes del producto.

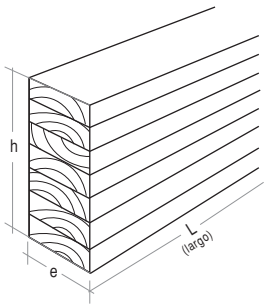
Manipulación y Almacenamiento

- Hilam debe ser almacenado bajo techo, protegido de la acción directa del sol y la lluvia.
- Almacenar siempre en posición horizontal, separando el producto del piso usando separadores limpios, secos y de dimensión similar. Usar suficientes separadores para evitar que el producto se pandee.
- Si se cubre con polietileno, permitir que el producto respire para evitar condensación.
- Evitar que el producto se ensucie o manche, ya que dificultará la aplicación del acabado final.
- Manipular cuidando de no dañar el producto, en especial durante el transporte y montaje.
- Manipular con precaución para evitar accidentes por golpes o caídas.

La información que se entrega se basa en cálculos estructurales conforme a las prescripciones de las normas chilenas vigentes. Sin embargo, los valores son referenciales y se requiere la participación de un calculista calificado para resolver cada proyecto. Por ello Arauco no asume responsabilidad derivada del incorrecto uso de la información.

Especificación de dimensiones, tolerancia y forma

Sección		
Espesor(e) mm	Altura(h) mm	Nº láminas
90	90	3
115	115	3
138	138	4
42	185	5
42	228	6
42	266	7
65	185	5
65	228	6
65	266	7
65	304	8
90	185	5
90	342	9
90	380	10
90	418	11
90	456	12
90	494	13
90	532	14
90	570	15
115	456	12
115	494	13
115	532	14
115	570	15
115	608	16
115	646	17
115	684	18
115	722	19
115	760	20
138	684	18
138	722	19
138	760	20
138	798	21
138	836	22
138	874	23
138	912	24
138	950	25
138	988	26
185	950	25
185	988	26



HILAM: Tolerancia dimensional, forma y ortogonalidad (NCh2148).

Tolerancias dimensiones

Espesor(e): +/- 2 mm.

Altura(h): + 1%
- 0,5%, con un máximo de 3 mm.

Largo(L): L hasta 6 m: +/- 2 mm.
L mayor a 6 mm : +/- 0,03%

Rectitud

No considera deformación por peso propio. Se aplica a elementos rectos o ligeramente curvados, no curvos.

L hasta 6 m: ± 6 mm

L mayor a 6 m: +/- (6 mm + 0,5 x (L-6)) en mm, con un máximo de 20 mm.

Escuadrado

Se mide ajustando una escuadra en la cara superior o inferior (cantos) y se mide la desviación en la cara.

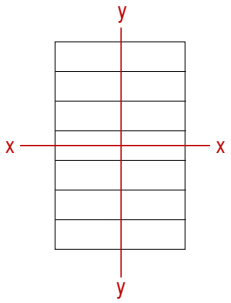
Escuadrado: +/- 1% de la altura especificada.

Producos Estándar disponibles en tiendas especializadas

Producto mm	Espesor(e) mm	Altura(h) láminas	Largo m
Pilares	90	90	2,5
	115	115	2,7
	138	138	2,7
Vigas	42	185	6
	42	228	6
	65	228	8
	65	304	10

Propiedades estáticas para el diseño

Sección									
Espesor mm	Altura mm	A mm^2	W_x mm^3	Wy mm^3	Ix mm^4	Iy mm^4	peso kgf/ml	Mx.ad Ton*m	Qx.ad Ton
42	185	7.770	239.575	54.390	22.160.688	1.142.190	3,9	0,21	0,57
42	228	9.576	363.888	67.032	41.483.232	1.407.672	4,8	0,32	0,70
42	266	11.172	495.292	78.204	65.873.836	1.642.284	5,6	0,46	0,82
65	228	14.820	563.160	160.550	64.200.240	5.217.875	7,4	0,50	1,09
65	266	17.290	766.523	187.308	101.947.603	6.087.521	8,6	0,71	1,27
65	304	19.760	1.001.173	214.067	152.178.347	6.957.167	9,9	0,92	1,45
90	342	30.780	1.754.460	461.700	300.012.660	20.776.500	15,4	1,57	2,26
90	380	34.200	2.166.000	513.000	411.540.000	23.085.000	17,1	1,68	2,51
90	418	37.620	2.620.860	564.300	547.759.740	25.393.500	18,8	1,99	2,76
90	456	41.040	3.119.040	615.600	711.141.120	27.702.000	20,5	2,33	3,01
90	494	44.460	3.660.540	666.900	904.153.380	30.010.500	22,2	2,78	3,26
90	532	47.880	4.245.360	718.200	1.129.265.760	32.319.000	23,9	3,18	3,51
90	570	51.300	4.873.500	769.500	1.388.947.500	34.627.500	25,7	3,60	3,76
115	456	52.440	3.985.440	1.005.100	908.680.320	57.793.250	26,2	2,97	3,85
115	494	56.810	4.677.357	1.088.858	1.155.307.097	62.609.354	28,4	3,55	4,17
115	532	61.180	5.424.627	1.172.617	1.442.950.693	67.425.458	30,6	4,06	4,49
115	570	65.550	6.227.250	1.256.375	1.774.766.250	72.241.563	32,8	4,60	4,81
115	608	69.920	7.085.227	1.340.133	2.153.908.907	77.057.667	35,0	5,17	5,13
115	646	74.290	7.998.557	1.423.892	2.583.533.803	81.873.771	37,1	5,77	5,45
115	684	78.660	8.967.240	1.507.650	3.066.796.080	86.689.875	39,3	6,40	5,77
115	722	83.030	9.991.277	1.591.408	3.606.850.877	91.505.979	41,5	7,23	6,09
115	760	87.400	11.070.667	1.675.167	4.206.853.333	96.322.083	43,7	7,93	6,41
138	684	94.392	10.760.688	2.171.016	3.680.155.296	149.800.104	47,2	7,68	6,92
138	722	99.636	11.989.532	2.291.628	4.328.221.052	158.122.332	49,8	8,67	7,31
138	760	104.880	13.284.800	2.412.240	5.048.224.000	166.444.560	52,4	9,51	7,69
138	798	110.124	14.646.492	2.532.852	5.843.950.308	174.766.788	55,1	10,39	8,08
138	836	115.368	16.074.608	2.653.464	6.719.186.144	183.089.016	57,7	11,30	8,46
138	874	120.612	17.569.148	2.774.076	7.677.717.676	191.411.244	60,3	12,24	8,84
138	912	125.856	19.130.112	2.894.688	8.723.331.072	199.733.472	62,9	13,22	9,23
138	950	131.100	20.757.500	3.015.300	9.859.812.500	208.055.700	65,6	14,50	9,61
138	988	136.344	22.451.312	3.135.912	11.090.948.128	216.377.928	68,2	15,57	10,00
185	950	175.750	27.827.083	5.418.958	13.217.864.583	501.253.646	87,9	19,44	12,89
185	988	182.780	30.097.773	5.635.717	14.868.300.027	521.303.792	91,4	20,87	13,40



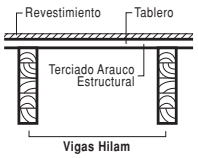
Mx, ad	momento flector admisible, válido para cargas de duración normal, según NCh 1198 (10 años).
Qx, ad	esfuerzo de corte admisible, válido para cargas de duración normal, según NCh 1198 (10 años), y condiciones en las que la altura útil es igual a la altura de la pieza.

Luces admisibles (en m) para vigas HILAM, en pisos residenciales

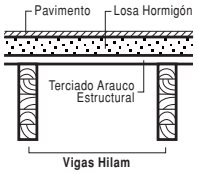
Límites de flecha L/300 para carga total
L/360 para sobrecarga de servicio 150 kgf/m^2

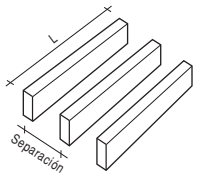
Sección Espesor mm	Sección Altura mm	Piso liviano (pp=60 kgf/m^2) Separación entre ejes de viga 0,8m	1,2m	1,6m	2,0m	2,40m	Piso acústico (pp=150 kgf/m^2) Separación entre ejes de viga 0,8m	1,2m	1,6m	2,0m	2,40m
42	185	3,204	2,616	2,266	2,026	1,850	2,681	2,189	1,896	1,695	1,548
42	228	3,919	3,200	2,771	2,478	2,263	3,279	2,677	2,318	2,074	1,893
42	266	4,666	3,810	3,300	2,951	2,694	3,904	3,188	2,761	2,469	2,254
65	228	4,590	3,980	3,447	3,083	2,815	4,076	3,330	2,884	2,580	2,355
65	266	5,429	4,740	4,105	3,672	3,352	4,820	3,966	3,434	3,072	2,804
65	304	6,187	5,390	4,668	4,175	3,811	5,493	4,510	3,905	3,493	3,189
90	342	7,735	6,757	6,112	5,467	4,991	6,868	5,905	5,114	4,574	4,176
90	380	8,571	7,293	6,316	5,649	5,157	7,473	6,102	5,284	4,726	4,314
90	418	9,403	7,948	6,883	6,157	5,620	8,144	6,650	5,759	5,151	4,702
90	456	10,233	8,597	7,445	6,659	6,079	8,809	7,193	6,229	5,572	5,086
90	494	11,184	9,396	8,137	7,278	6,644	9,628	7,861	6,808	6,089	5,559
90	532	12,021	10,049	8,702	7,784	7,105	10,297	8,407	7,281	6,512	5,945
90	570	12,856	10,695	9,263	8,285	7,563	10,960	8,948	7,750	6,931	6,328
115	456	11,104	9,700	8,416	7,528	6,872	9,859	8,131	7,041	6,298	5,749
115	494	12,136	10,602	9,198	8,227	7,510	10,776	8,886	7,696	6,883	6,284
115	532	13,045	11,359	9,837	8,799	8,032	11,583	9,504	8,230	7,361	6,720
115	570	13,951	12,090	10,470	9,365	8,549	12,387	10,115	8,760	7,835	7,153
115	608	14,854	12,816	11,099	9,927	9,062	13,132	10,722	9,286	8,305	7,582
115	646	15,756	13,536	11,723	10,485	9,572	13,870	11,325	9,808	8,772	8,008
115	684	16,656	14,252	12,343	11,040	10,078	14,604	11,924	10,327	9,237	8,432
115	722	17,695	15,146	13,116	11,732	10,710	15,520	12,672	10,974	9,815	8,960
115	760	18,601	15,864	13,739	12,289	11,218	16,256	13,273	11,495	10,281	9,386
138	684	17,699	15,462	13,521	12,093	11,040	15,715	13,062	11,312	10,118	9,237
138	722	18,804	16,427	14,368	12,851	11,732	16,696	13,881	12,021	10,752	9,815
138	760	19,766	17,268	15,050	13,461	12,289	17,551	14,540	12,592	11,263	10,281
138	798	20,727	18,107	15,728	14,068	12,842	18,404	15,195	13,159	11,770	10,745
138	836	21,686	18,940	16,403	14,671	13,393	19,255	15,847	13,724	12,275	11,205
138	874	22,643	19,715	17,074	15,271	13,941	20,105	16,495	14,285	12,777	11,664
138	912	23,599	20,487	17,742	15,869	14,486	20,954	17,140	14,844	13,277	12,120
138	950	24,708	21,456	18,581	16,620	15,171	21,938	17,951	15,546	13,905	12,693
138	988	25,669	22,229	19,251	17,219	15,719	22,778	18,598	16,107	14,406	13,151
185	950	27,244	23,800	21,514	19,243	17,566	24,190	20,784	17,000	16,100	14,697
185	988	28,303	24,725	22,290	19,937	18,199	25,130	21,534	18,649	16,680	15,227

Piso Liviano



Piso Acústico





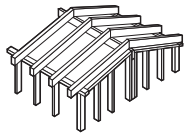
Nota:

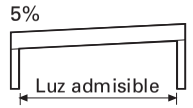
Piso liviano piso estructurado con entablado o terciado estructural de 18mm. Pavimento alfombra, vinílico o similar.

Piso acústico piso estructurado con terciado estructural de 18 mm, losa de hormigón de 5 cm. Pavimento alfombra, vinílico o similar.

⋆ Se considera un rango normal de uso entre 4 y 10 m. Los valores sobre 10 m (marcados en gris) son sólo referenciales. Bajo 4 m se puede usar MSD Estructural.

Tabla 4 Hilam Estándar





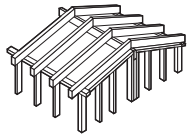
Luces admisibles (en m) para vigas HILAM, en techos

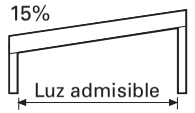
Inclinación 5% (2,9º)

Peso del techo		15 kgf/m²					30 kgf/m²					60 kgf/m²					120 kgf/m²				
Sección		Módulo					Módulo					Módulo					Módulo				
Espesor mm	Altura mm	0,8m	1,2m	1,6m	2,0m	2,40m	0,8m	1,2m	1,6m	2,0m	2,40m	0,8m	1,2m	1,6m	2,0m	2,40m	0,8m	1,2m	1,6m	2,0m	2,40m
42	185	4,690	4,097	3,610	3,229	2,948	4,483	3,896	3,374	3,018	2,755	4,157	3,479	3,013	2,695	2,460	3,595	2,935	2,542	2,274	2,076
42	228	5,751	5,024	4,416	3,950	3,605	5,497	4,764	4,126	3,691	3,369	5,098	4,255	3,685	3,296	3,009	4,397	3,590	3,109	2,781	2,539
42	266	6,802	5,942	5,258	4,703	4,293	6,501	5,674	4,913	4,395	4,012	6,029	5,067	4,388	3,925	3,583	5,236	4,275	3,702	3,312	3,023
65	228	6,652	5,811	5,280	4,901	4,485	6,358	5,554	5,046	4,591	4,191	5,897	5,151	4,584	4,100	3,743	5,184	4,466	3,868	3,460	3,158
65	266	7,868	6,873	6,245	5,797	5,341	7,520	6,569	5,969	5,467	4,991	6,974	6,092	5,459	4,883	4,457	6,131	5,318	4,606	4,120	3,761
65	304	8,966	7,833	7,116	6,606	6,074	8,570	7,486	6,802	6,217	5,675	7,947	6,943	6,208	5,552	5,069	6,987	6,048	5,238	4,685	4,276
90	342	11,210	9,793	8,897	8,260	7,773	10,714	9,360	8,504	7,894	7,429	9,936	8,680	7,887	7,271	6,637	8,736	7,631	6,858	6,134	5,600
90	380	12,421	10,850	9,858	9,002	8,218	11,872	10,371	9,404	8,412	7,679	11,010	9,618	8,399	7,512	6,858	9,679	8,183	7,087	6,338	5,786
90	418	13,627	11,904	10,816	9,811	8,956	13,024	11,378	10,250	9,168	8,369	12,079	10,552	9,154	8,188	7,474	10,619	8,918	7,723	6,908	6,306
90	456	14,829	12,954	11,770	10,612	9,687	14,173	12,382	11,086	9,916	9,052	13,144	11,433	9,901	8,856	8,084	11,556	9,646	8,354	7,472	6,821
90	494	16,208	14,159	12,864	11,598	10,588	15,491	13,533	12,117	10,838	9,893	14,366	12,496	10,822	9,679	8,836	12,630	10,543	9,130	8,167	7,455
90	532	17,421	15,219	13,827	12,404	11,323	16,651	14,546	12,958	11,590	10,580	15,442	13,363	11,573	10,351	9,449	13,576	11,275	9,764	8,734	7,973
90	570	18,631	16,276	14,760	13,202	12,052	17,807	15,556	13,792	12,336	11,262	16,514	14,224	12,318	11,018	10,058	14,519	12,001	10,393	9,296	8,486
115	456	16,091	14,057	12,772	11,856	10,950	15,380	13,436	12,207	11,209	10,232	14,263	12,460	11,192	10,011	9,138	12,540	10,904	9,443	8,446	7,710
115	494	17,588	15,364	13,959	12,959	11,968	16,810	14,685	13,342	12,251	11,183	15,590	13,619	12,233	10,941	9,988	13,706	11,918	10,321	9,231	8,427
115	532	18,904	16,515	15,004	13,929	12,799	18,069	15,784	14,341	13,102	11,960	16,757	14,638	13,082	11,701	10,681	14,732	12,745	11,038	9,872	9,012
115	570	20,217	17,661	16,046	14,896	13,623	19,323	16,881	15,337	13,945	12,730	17,920	15,655	13,924	12,454	11,369	15,755	13,566	11,748	10,508	9,592
115	608	21,527	18,805	17,086	15,819	14,441	20,575	17,974	16,330	14,782	13,494	19,081	16,669	14,760	13,202	12,051	16,776	14,380	12,453	11,139	10,168
115	646	22,833	19,947	18,123	16,709	15,253	21,824	19,065	17,322	15,613	14,253	20,239	17,681	15,590	13,944	12,729	17,794	15,188	13,153	11,765	10,740
115	684	24,137	21,086	19,158	17,593	16,060	23,070	20,154	18,311	16,439	15,007	21,395	18,690	16,414	14,682	13,402	18,810	15,992	13,849	12,387	11,308
115	722	25,644	22,402	20,354	18,695	17,066	24,510	21,412	19,454	17,469	15,947	22,731	19,857	17,443	15,602	14,242	19,984	16,994	14,717	13,164	12,017
115	760	26,956	23,549	21,395	19,583	17,876	25,765	22,507	20,449	18,298	16,704	23,894	20,873	18,271	16,342	14,918	21,007	17,801	15,416	13,788	12,587
138	684	25,650	22,407	20,358	18,899	17,593	24,516	21,416	19,458	18,008	16,439	22,736	19,861	17,981	16,083	14,682	19,989	17,462	15,171	13,569	12,387
138	722	27,251	23,806	21,629	20,079	18,695	26,046	22,753	20,673	19,137	17,469	24,155	21,101	19,108	17,091	15,602	21,236	18,552	16,122	14,420	13,164
138	760	28,645	25,024	22,736	21,106	19,583	27,379	23,918	21,731	20,045	18,298	25,391	22,181	20,015	17,902	16,342	22,323	19,500	16,887	15,104	13,788
138	798	30,037	26,240	23,841	22,132	20,465	28,709	25,080	22,787	20,948	19,123	26,625	23,259	20,917	18,709	17,079	23,408	20,378	17,648	15,785	14,410
138	836	31,427	27,454	24,943	23,155	21,342	30,037	26,240	23,841	21,846	19,943	27,857	24,335	21,814	19,511	17,811	24,491	21,252	18,405	16,462	15,027
138	874	32,814	28,666	26,045	24,178	22,216	31,363	27,398	24,893	22,740	20,759	29,086	25,409	22,706	20,309	18,540	25,572	22,122	19,158	17,135	15,642
138	912	34,199	29,876	27,144	25,198	23,085	32,687	28,555	25,944	23,630	21,571	30,314	26,482	23,595	21,104	19,265	26,651	22,987	19,907	17,806	16,254
138	950	35,807	31,280	28,420	26,383	24,177	34,224	29,897	27,163	24,747	22,591	31,739	27,727	24,711	22,102	20,176	27,904	24,074	20,849	18,648	17,023
138	988	37,199	32,496	29,525	27,408	25,049	35,554	31,060	28,219	25,640	23,406	32,973	28,805	25,602	22,899	20,904	28,989	24,942	21,601	19,320	17,637
185	950	39,482	34,490	31,337	29,090	27,375	37,736	32,966	29,951	27,804	26,157	34,996	30,572	27,777	25,590	23,361	30,768	26,878	24,140	21,591	19,710
185	988	41,017	35,831	32,555	30,221	28,439	39,203	34,247	31,116	28,885	27,100	36,357	31,761	28,857	26,513	24,203	31,964	27,923	25,010	22,370	20,421

** Se considera un rango normal de aplicación entre 4 y 12 m de luz libre. Los valores sobre 12 m (marcados en gris) son sólo referenciales. Bajo 4 m se puede usar MSD Estructural.*

Tabla 5 Hilam Estándar





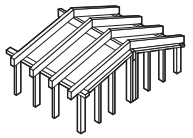
Luces admisibles (en m) para vigas HILAM, en techos

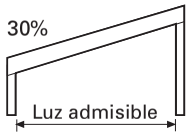
Inclinación 15% (8,53º)

Peso del techo		15 kgf/m²					30 kgf/m²					60 kgf/m²					120 kgf/m²				
Sección Espesor mm	Altura mm	Módulo 0,8m	1,2m	1,6m	2,0m	2,40m	Módulo 0,8m	1,2m	1,6m	2,0m	2,40m	Módulo 0,8m	1,2m	1,6m	2,0m	2,40m	Módulo 0,8m	1,2m	1,6m	2,0m	2,40m
42	185	5,087	4,444	4,038	3,666	3,346	4,802	4,195	3,759	3,362	3,069	4,380	3,780	3,274	2,928	2,673	3,703	3,105	2,689	2,405	2,195
42	228	6,238	5,449	4,951	4,483	4,093	5,888	5,143	4,597	4,112	3,753	5,370	4,623	4,004	3,581	3,269	4,541	3,797	3,288	2,941	2,685
42	266	7,377	6,445	5,855	5,339	4,874	6,964	6,083	5,474	4,896	4,469	6,351	5,506	4,768	4,265	3,893	5,370	4,522	3,916	3,502	3,197
65	228	7,215	6,303	5,727	5,316	5,003	6,810	5,949	5,405	5,018	4,669	6,212	5,426	4,930	4,455	4,067	5,252	4,588	4,091	3,659	3,340
65	266	8,533	7,455	6,773	6,287	5,917	8,055	7,036	6,393	5,935	5,560	7,346	6,418	5,831	5,305	4,843	6,212	5,426	4,871	4,357	3,978
65	304	9,725	8,495	7,718	7,165	6,743	9,179	8,019	7,286	6,763	6,323	8,372	7,314	6,645	6,033	5,507	7,079	6,184	5,539	4,955	4,523
90	342	12,158	10,621	9,650	8,958	8,430	11,476	10,026	9,109	8,456	7,957	10,467	9,144	8,308	7,712	7,211	8,850	7,732	7,025	6,488	5,923
90	380	13,472	11,769	10,692	9,926	9,328	12,716	11,108	10,093	9,369	8,555	11,598	10,132	9,126	8,163	7,451	9,806	8,567	7,495	6,704	6,120
90	418	14,780	12,911	11,731	10,890	10,167	13,951	12,187	11,073	10,213	9,323	12,724	11,115	9,946	8,896	8,121	10,759	9,398	8,169	7,306	6,670
90	456	16,084	14,050	12,766	11,851	10,997	15,182	13,262	12,050	11,047	10,085	13,847	12,096	10,758	9,622	8,784	11,708	10,202	8,835	7,903	7,214
90	494	17,579	15,357	13,953	12,952	12,019	16,593	14,495	13,170	12,074	11,022	15,134	13,221	11,758	10,517	9,601	12,796	11,151	9,657	8,637	7,885
90	532	18,895	16,507	14,997	13,922	12,853	17,835	15,581	14,156	12,912	11,787	16,267	14,211	12,575	11,247	10,267	13,754	11,925	10,327	9,237	8,432
90	570	20,208	17,653	16,039	14,889	13,681	19,074	16,663	15,139	13,744	12,546	17,397	15,197	13,384	11,971	10,928	14,710	12,693	10,992	9,832	8,975
115	456	17,453	15,247	13,853	12,860	12,101	16,474	14,391	13,075	12,138	11,399	15,025	13,126	11,926	10,877	9,929	12,705	11,098	9,988	8,933	8,155
115	494	19,076	16,664	15,140	14,055	13,226	18,006	15,729	14,291	13,267	12,459	16,422	14,346	13,034	11,888	10,852	13,886	12,130	10,916	9,764	8,913
115	532	20,504	17,912	16,274	15,107	14,217	19,354	16,907	15,361	14,260	13,324	17,652	15,420	14,010	12,714	11,606	14,925	13,039	11,674	10,441	9,532
115	570	21,928	19,156	17,404	16,157	15,204	20,698	18,081	16,428	15,250	14,182	18,878	16,491	14,983	13,532	12,353	15,962	13,944	12,425	11,114	10,145
115	608	23,348	20,397	18,532	17,203	16,189	22,039	19,252	17,492	16,238	15,033	20,101	17,559	15,954	14,344	13,094	16,996	14,847	13,171	11,781	10,754
115	646	24,765	21,635	19,656	18,247	17,171	23,376	20,421	18,554	17,224	15,878	21,321	18,625	16,922	15,151	13,831	18,027	15,748	13,912	12,443	11,359
115	684	26,180	22,870	20,779	19,289	18,152	24,711	21,587	19,613	18,207	16,718	22,538	19,689	17,835	15,952	14,562	19,057	16,648	14,648	13,101	11,960
115	722	27,814	24,298	22,076	20,493	19,285	26,254	22,935	20,838	19,344	17,766	23,945	20,918	18,953	16,952	15,475	20,246	17,687	15,566	13,922	12,709
115	760	29,237	25,541	23,206	21,542	20,272	27,597	24,108	21,904	20,334	18,609	25,170	21,988	19,853	17,757	16,210	21,283	18,592	16,304	14,583	13,313
138	684	27,820	24,303	22,081	20,498	19,289	26,259	22,940	20,842	19,348	18,207	23,950	20,923	19,009	17,475	15,952	20,251	17,691	16,046	14,352	13,101
138	722	29,557	25,820	23,459	21,778	20,493	27,899	24,372	22,143	20,556	19,344	25,445	22,229	20,196	18,570	16,952	21,515	18,795	17,051	15,251	13,922
138	760	31,069	27,142	24,660	22,892	21,542	29,327	25,619	23,276	21,608	20,334	26,748	23,366	21,230	19,451	17,757	22,616	19,757	17,861	15,975	14,583
138	798	32,579	28,460	25,858	24,004	22,589	30,752	26,864	24,408	22,658	21,304	28,047	24,502	22,261	20,328	18,557	23,715	20,717	18,665	16,695	15,240
138	836	34,086	29,777	27,054	25,115	23,634	32,174	28,107	25,537	23,706	22,218	29,345	25,635	23,291	21,199	19,352	24,812	21,675	19,466	17,411	15,894
138	874	35,591	31,091	28,248	26,224	24,677	33,594	29,347	26,664	24,753	23,127	30,640	26,767	24,319	22,067	20,144	25,907	22,632	20,262	18,123	16,544
138	912	37,093	32,404	29,441	27,331	25,719	35,013	30,586	27,790	25,798	24,032	31,934	27,897	25,346	22,930	20,932	27,001	23,588	21,055	18,832	17,191
138	950	38,837	33,927	30,825	28,615	26,928	36,658	32,024	29,096	27,010	25,168	33,435	29,208	26,537	24,015	21,922	28,270	24,696	22,051	19,723	18,004
138	988	40,347	35,246	32,023	29,728	27,975	38,083	33,269	30,227	28,060	26,076	34,734	30,343	27,569	24,881	22,713	29,369	25,656	22,846	20,434	18,654
185	950	42,823	37,409	33,988	31,552	29,691	40,420	35,311	32,082	29,782	28,026	36,866	32,205	29,261	27,163	25,382	31,172	27,231	24,741	22,836	20,846
185	988	44,487	38,863	35,310	32,779	30,846	41,992	36,683	33,329	30,940	29,116	38,299	33,458	30,398	28,219	26,298	32,384	28,290	25,703	23,659	21,598

** Se considera un rango normal de aplicación entre 4 y 12 m de luz libre. Los valores sobre 12 m (marcados en gris) son sólo referenciales. Bajo 4 m se puede usar MSD Estructural.*

Tabla 6 Hilam Estándar





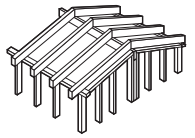
Luces admisibles (en m) para vigas HILAM, en techos

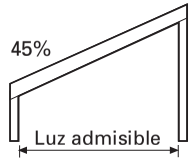
Inclinación 30% (16,7º)

Peso del techo		15 kgf/m²					30 kgf/m²					60 kgf/m²					120 kgf/m²				
Sección Espesor mm	Altura mm	Módulo 0,8m	1,2m	1,6m	2,0m	2,40m	Módulo 0,8m	1,2m	1,6m	2,0m	2,40m	Módulo 0,8m	1,2m	1,6m	2,0m	2,40m	Módulo 0,8m	1,2m	1,6m	2,0m	2,40m
42	185	6,069	5,302	4,817	4,472	4,208	5,492	4,798	4,359	4,047	3,808	4,586	4,006	3,640	3,379	3,112	3,648	3,187	2,895	2,634	2,404
42	228	7,441	6,501	5,906	5,483	5,160	6,735	5,883	5,345	4,962	4,670	5,623	4,912	4,463	4,143	3,806	4,473	3,908	3,550	3,221	2,941
42	266	8,801	7,688	6,985	6,485	6,102	7,965	6,958	6,322	5,869	5,523	6,650	5,809	5,278	4,900	4,533	5,290	4,621	4,199	3,836	3,502
65	228	8,608	7,519	6,832	6,342	5,968	7,790	6,805	6,183	5,740	5,401	6,504	5,682	5,162	4,792	4,510	5,174	4,520	4,107	3,812	3,587
65	266	10,180	8,893	8,080	7,501	7,059	9,213	8,048	7,312	6,788	6,388	7,692	6,720	6,105	5,668	5,334	6,119	5,346	4,857	4,509	4,243
65	304	11,601	10,135	9,208	8,548	8,044	10,499	9,172	8,333	7,736	7,280	8,766	7,658	6,958	6,459	6,078	6,973	6,092	5,535	5,138	4,835
90	342	14,505	12,671	11,512	10,687	10,057	13,127	11,467	10,419	9,672	9,102	10,960	9,574	8,699	8,075	7,599	8,719	7,617	6,920	6,424	6,045
90	380	16,071	14,040	12,756	11,842	11,143	14,545	12,706	11,544	10,717	10,085	12,144	10,609	9,639	8,948	8,420	9,660	8,439	7,668	7,118	6,698
90	418	17,632	15,403	13,995	12,991	12,225	15,957	13,940	12,665	11,757	11,064	13,323	11,639	10,574	9,816	9,238	10,598	9,259	8,412	7,809	7,305
90	456	19,188	16,762	15,229	14,138	13,304	17,365	15,170	13,783	12,795	12,040	14,498	12,665	11,507	10,682	10,053	11,534	10,075	9,154	8,498	7,901
90	494	20,972	18,320	16,645	15,452	14,541	18,979	16,580	15,064	13,984	13,160	15,846	13,843	12,577	11,676	10,987	12,606	11,012	10,005	9,288	8,636
90	532	22,542	19,692	17,891	16,609	15,630	20,400	17,821	16,192	15,031	14,145	17,033	14,880	13,519	12,550	11,810	13,550	11,837	10,754	9,984	9,235
90	570	24,107	21,060	19,134	17,762	16,715	21,817	19,059	17,316	16,075	15,127	18,216	15,913	14,458	13,421	12,630	14,491	12,659	11,501	10,677	9,830
115	456	20,821	18,189	16,526	15,341	14,437	18,843	16,461	14,956	13,884	13,065	15,733	13,744	12,487	11,592	10,908	12,515	10,933	9,934	9,221	8,678
115	494	22,757	19,880	18,062	16,768	15,779	20,595	17,992	16,346	15,175	14,280	17,195	15,022	13,648	12,670	11,923	13,679	11,950	10,857	10,079	9,485
115	532	24,461	21,369	19,415	18,023	16,960	22,137	19,339	17,570	16,311	15,349	18,483	16,146	14,670	13,618	12,815	14,703	12,845	11,670	10,833	10,195
115	570	26,160	22,853	20,763	19,275	18,138	23,675	20,682	18,791	17,444	16,415	19,767	17,268	15,689	14,564	13,705	15,724	13,737	12,480	11,586	10,903
115	608	27,854	24,333	22,108	20,523	19,313	25,208	22,021	20,008	18,573	17,478	21,047	18,386	16,705	15,507	14,593	16,743	14,626	13,289	12,336	11,609
115	646	29,545	25,810	23,450	21,769	20,485	26,738	23,358	21,222	19,701	18,539	22,324	19,502	17,719	16,449	15,479	17,759	15,514	14,095	13,085	12,313
115	684	31,232	27,283	24,789	23,012	21,655	28,265	24,692	22,434	20,826	19,598	23,599	20,616	18,731	17,388	16,363	18,773	16,400	14,900	13,832	13,017
115	722	33,181	28,987	26,336	24,448	23,007	30,029	26,233	23,834	22,126	20,821	25,072	21,903	19,900	18,473	17,384	19,945	17,424	15,830	14,696	13,829
115	760	34,880	30,470	27,684	25,699	24,184	31,566	27,576	25,054	23,258	21,887	26,355	23,024	20,918	19,419	18,274	20,966	18,315	16,641	15,448	14,537
138	684	33,189	28,993	26,342	24,454	23,012	30,036	26,239	23,840	22,131	20,826	25,078	21,907	19,904	18,477	17,388	19,950	17,428	15,834	14,699	13,832
138	722	35,260	30,803	27,986	25,980	24,448	31,911	27,877	25,328	23,512	22,126	26,643	23,275	21,147	19,631	18,473	21,195	18,515	16,822	15,617	14,696
138	760	37,065	32,379	29,419	27,310	25,699	33,544	29,303	26,624	24,716	23,258	28,007	24,466	22,229	20,636	19,419	22,280	19,463	17,683	16,416	15,448
138	798	38,866	33,953	30,848	28,637	26,948	35,174	30,727	27,918	25,916	24,388	29,368	25,655	23,309	21,638	20,362	23,362	20,409	18,543	17,213	16,198
138	836	40,664	35,523	32,275	29,961	28,195	36,801	32,149	29,209	27,115	25,517	30,726	26,842	24,387	22,639	21,304	24,443	21,353	19,400	18,010	16,948
138	874	42,459	37,091	33,700	31,284	29,439	38,426	33,568	30,499	28,312	26,643	32,083	28,027	25,464	23,639	22,245	25,522	22,295	20,257	18,805	17,696
138	912	44,252	38,657	35,122	32,605	30,682	40,048	34,985	31,786	29,508	27,768	33,437	29,210	26,539	24,637	23,184	26,599	23,237	21,112	19,599	18,443
138	950	46,331	40,474	36,773	34,137	32,124	41,930	36,629	33,280	30,894	29,073	35,008	30,583	27,786	25,794	24,274	27,849	24,329	22,104	20,520	19,310
138	988	48,133	42,048	38,203	35,464	33,373	43,560	38,054	34,574	32,096	30,203	36,370	31,772	28,867	26,797	25,217	28,932	25,275	22,964	21,317	20,061
185	950	51,086	44,628	40,547	37,641	35,421	46,234	40,389	36,696	34,065	32,057	38,601	33,721	30,638	28,442	26,765	30,708	26,826	24,373	22,626	21,292
185	988	53,073	46,363	42,124	39,104	36,799	48,031	41,959	38,122	35,390	33,303	40,102	35,033	31,829	29,548	27,805	31,902	27,869	25,320	23,505	22,119

** Se considera un rango normal de aplicación entre 4 y 12 m de luz libre. Los valores sobre 12 m (marcados en gris) son sólo referenciales. Bajo 4 m se puede usar MSD Estructural.*

Tabla 7 — Hilam Estándar





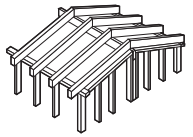
Luces admisibles (en m) para vigas HILAM, en techos

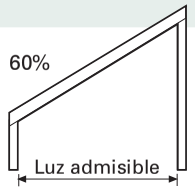
Inclinación 45% (24,23º)

Peso del techo		15 kgf/m²					30 kgf/m²					60 kgf/m²					120 kgf/m²				
Sección		Módulo					Módulo					Módulo					Módulo				
Espesor mm	Altura mm	0,8m	1,2m	1,6m	2,0m	2,40m	0,8m	1,2m	1,6m	2,0m	2,40m	0,8m	1,2m	1,6m	2,0m	2,40m	0,8m	1,2m	1,6m	2,0m	2,40m
42	185	5,910	5,163	4,691	4,355	4,098	5,321	4,648	4,223	3,920	3,689	4,422	3,863	3,510	3,258	3,039	3,509	3,066	2,785	2,563	2,340
42	228	7,384	6,451	5,861	5,441	5,120	6,648	5,807	5,276	4,898	4,609	5,525	4,826	4,385	4,071	3,822	4,384	3,830	3,480	3,224	2,943
42	266	8,591	7,505	6,818	6,330	5,956	7,733	6,756	6,138	5,698	5,362	6,427	5,615	5,101	4,736	4,440	5,101	4,456	4,048	3,745	3,418
65	228	8,542	7,462	6,779	6,294	5,922	7,689	6,717	6,103	5,665	5,331	6,391	5,583	5,072	4,709	4,431	5,071	4,430	4,025	3,737	3,516
65	266	9,937	8,681	7,887	7,322	6,890	8,945	7,814	7,100	6,591	6,202	7,434	6,495	5,901	5,478	5,155	5,900	5,154	4,683	4,347	4,091
65	304	11,323	9,892	8,987	8,343	7,851	10,193	8,905	8,090	7,510	7,068	8,472	7,401	6,724	6,242	5,874	6,723	5,873	5,336	4,954	4,662
90	342	14,198	12,403	11,269	10,461	9,845	12,781	11,166	10,145	9,417	8,862	10,623	9,280	8,431	7,827	7,365	8,430	7,364	6,691	6,211	5,845
90	380	15,732	13,743	12,486	11,591	10,908	14,162	12,371	11,240	10,435	9,819	11,770	10,282	9,342	8,672	8,161	9,341	8,160	7,414	6,882	6,476
90	418	17,259	15,077	13,699	12,717	11,967	15,537	13,573	12,332	11,448	10,773	12,913	11,280	10,249	9,514	8,953	10,247	8,952	8,133	7,550	7,105
90	456	18,782	16,408	14,907	13,839	13,023	16,908	14,770	13,420	12,458	11,723	14,052	12,276	11,153	10,354	9,743	11,152	9,742	8,851	8,217	7,732
90	494	20,528	17,933	16,293	15,126	14,234	18,480	16,144	14,667	13,616	12,813	15,359	13,417	12,190	11,316	10,649	12,188	10,648	9,674	8,981	8,451
90	532	22,066	19,276	17,514	16,258	15,300	19,864	17,352	15,766	14,636	13,773	16,509	14,422	13,103	12,164	11,447	13,101	11,445	10,398	9,653	9,054
90	570	23,598	20,615	18,730	17,387	16,362	21,243	18,557	16,860	15,652	14,729	17,655	15,423	14,013	13,008	12,241	14,011	12,240	11,120	10,323	9,639
115	456	20,381	17,805	16,177	15,017	14,132	18,347	16,028	14,562	13,518	12,721	15,249	13,321	12,103	11,235	10,573	12,101	10,571	9,605	8,916	8,390
115	494	22,276	19,460	17,681	16,413	15,445	20,053	17,518	15,916	14,775	13,904	16,666	14,559	13,228	12,280	11,556	13,226	11,554	10,498	9,745	9,171
115	532	23,944	20,917	19,005	17,642	16,602	21,555	18,830	17,108	15,882	14,945	17,914	15,650	14,219	13,199	12,421	14,217	12,419	11,284	10,475	9,857
115	570	25,607	22,370	20,324	18,867	17,755	23,051	20,137	18,296	16,984	15,983	19,158	16,736	15,206	14,116	13,284	15,204	13,282	12,067	11,202	10,542
115	608	27,266	23,819	21,641	20,089	18,905	24,544	21,442	19,481	18,085	17,018	20,399	17,820	16,191	15,030	14,144	16,189	14,142	12,849	11,928	11,225
115	646	28,920	25,264	22,954	21,308	20,052	26,034	22,743	20,663	19,182	18,051	21,637	18,902	17,173	15,942	15,002	17,171	15,000	13,629	12,652	11,906
115	684	30,572	26,707	24,265	22,525	21,197	27,521	24,042	21,843	20,277	19,082	22,873	19,981	18,154	16,853	15,859	18,152	15,857	14,407	13,374	12,586
115	722	32,480	28,374	25,780	23,932	22,521	29,239	25,542	23,207	21,543	20,273	24,301	21,229	19,287	17,905	16,849	19,285	16,847	15,306	14,209	13,371
115	760	34,142	29,826	27,099	25,156	23,673	30,735	26,850	24,394	22,646	21,311	25,544	22,315	20,275	18,821	17,711	20,272	17,709	16,090	14,936	14,056
138	684	32,487	28,380	25,785	23,937	22,525	29,245	25,548	23,212	21,548	20,277	24,306	21,233	19,292	17,909	16,853	19,289	16,850	15,310	14,212	13,374
138	722	34,515	30,152	27,395	25,431	23,932	31,071	27,143	24,661	22,893	21,543	25,823	22,559	20,496	19,027	17,905	20,493	17,902	16,265	15,099	14,209
138	760	36,282	31,695	28,797	26,733	25,156	32,661	28,532	25,923	24,065	22,646	27,145	23,713	21,545	20,000	18,821	21,542	18,819	17,098	15,872	14,936
138	798	38,046	33,236	30,197	28,032	26,379	34,249	29,919	27,183	25,235	23,747	28,464	24,866	22,592	20,973	19,736	22,589	19,733	17,929	16,644	15,662
138	836	39,804	34,772	31,593	29,328	27,599	35,832	31,302	28,440	26,401	24,845	29,780	26,016	23,637	21,942	20,649	23,633	20,646	18,758	17,413	16,386
138	874	41,563	36,308	32,988	30,624	28,818	37,415	32,685	29,696	27,567	25,942	31,096	27,165	24,681	22,912	21,561	24,677	21,558	19,586	18,182	17,110
138	912	43,316	37,840	34,380	31,916	30,034	38,994	34,064	30,949	28,731	27,037	32,408	28,311	25,722	23,878	22,470	25,719	22,467	20,413	18,950	17,832
138	950	45,352	39,619	35,996	33,416	31,446	40,826	35,665	32,404	30,081	28,307	33,931	29,642	26,931	25,001	23,526	26,927	23,523	21,372	19,840	18,670
138	988	47,116	41,159	37,396	34,715	32,668	42,413	37,052	33,664	31,251	29,408	35,250	30,794	27,978	25,973	24,441	27,974	24,438	22,203	20,612	19,396
185	950	49,901	43,592	39,606	36,767	34,599	44,921	39,242	35,654	33,098	31,146	37,334	32,614	29,632	27,508	25,886	29,628	25,882	23,516	21,830	20,543
185	988	51,844	45,290	41,149	38,199	35,947	46,670	40,770	37,042	34,387	32,359	38,788	33,885	30,786	28,579	26,894	30,782	26,890	24,432	22,680	21,343

** Se considera un rango normal de aplicación entre 4 y 12 m de luz libre. Los valores sobre 12 m (marcados en gris) son sólo referenciales. Bajo 4 m se puede usar MSD Estructural.*

Tabla 8 Hilam Estándar





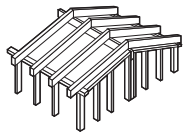
Luces admisibles (en m) para vigas HILAM, en techos

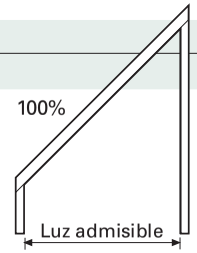
Inclinación 60% (31º)

Peso del techo		15 kgf/m²					30 kgf/m²					60 kgf/m²					120 kgf/m²				
Sección Espesor mm	Altura mm	Módulo 0,8m	1,2m	1,6m	2,0m	2,40m	Módulo 0,8m	1,2m	1,6m	2,0m	2,40m	Módulo 0,8m	1,2m	1,6m	2,0m	2,40m	Módulo 0,8m	1,2m	1,6m	2,0m	2,40m
42	185	5,777	5,047	4,585	4,257	4,006	5,167	4,514	4,101	3,807	3,583	4,272	3,732	3,391	3,148	2,962	3,381	2,954	2,684	2,491	2,299
42	228	7,084	6,188	5,622	5,219	4,912	6,336	5,535	5,029	4,668	4,393	5,238	4,576	4,158	3,860	3,632	4,146	3,622	3,291	3,055	2,812
42	266	8,378	7,319	6,650	6,173	5,809	7,493	6,546	5,947	5,521	5,195	6,195	5,412	4,917	4,565	4,296	4,904	4,284	3,892	3,613	3,348
65	228	8,194	7,158	6,503	6,037	5,681	7,328	6,402	5,817	5,400	5,081	6,059	5,293	4,809	4,464	4,201	4,796	4,190	3,806	3,534	3,325
65	266	9,691	8,466	7,692	7,140	6,719	8,667	7,572	6,879	6,386	6,010	7,166	6,260	5,688	5,280	4,969	5,672	4,955	4,502	4,179	3,933
65	304	11,044	9,647	8,765	8,137	7,657	9,877	8,629	7,840	7,278	6,849	8,166	7,134	6,482	6,017	5,662	6,464	5,647	5,130	4,763	4,482
90	342	13,807	12,062	10,959	10,173	9,574	12,349	10,788	9,802	9,099	8,563	10,210	8,919	8,104	7,523	7,079	8,082	7,060	6,414	5,955	5,603
90	380	15,299	13,365	12,143	11,272	10,608	13,683	11,953	10,860	10,082	9,487	11,313	9,883	8,979	8,335	7,844	8,954	7,822	7,107	6,598	6,209
90	418	16,784	14,662	13,322	12,367	11,638	15,012	13,114	11,915	11,061	10,409	12,411	10,842	9,851	9,145	8,606	9,824	8,582	7,797	7,238	6,812
90	456	18,265	15,956	14,497	13,458	12,664	16,336	14,271	12,966	12,037	11,327	13,506	11,799	10,720	9,952	9,365	10,691	9,339	8,485	7,877	7,412
90	494	19,963	17,440	15,845	14,709	13,842	17,855	15,598	14,172	13,156	12,380	14,762	12,896	11,717	10,877	10,236	11,685	10,207	9,274	8,609	8,102
90	532	21,458	18,745	17,031	15,810	14,878	19,192	16,766	15,233	14,141	13,307	15,867	13,862	12,594	11,691	11,002	12,559	10,972	9,968	9,254	8,708
90	570	22,948	20,047	18,214	16,908	15,911	20,525	17,930	16,290	15,123	14,231	16,969	14,824	13,469	12,503	11,766	13,432	11,734	10,661	9,897	9,313
115	456	19,820	17,314	15,731	14,604	13,743	17,727	15,486	14,070	13,061	12,291	14,656	12,804	11,633	10,799	10,162	11,601	10,134	9,208	8,548	8,044
115	494	21,663	18,924	17,194	15,961	15,020	19,375	16,926	15,378	14,276	13,434	16,019	13,994	12,714	11,803	11,107	12,679	11,076	10,064	9,342	8,791
115	532	23,285	20,341	18,481	17,156	16,145	20,826	18,193	16,529	15,345	14,440	17,218	15,042	13,666	12,687	11,939	13,629	11,906	10,817	10,042	9,450
115	570	24,902	21,754	19,765	18,348	17,266	22,272	19,456	17,677	16,410	15,443	18,414	16,086	14,615	13,568	12,768	14,575	12,733	11,568	10,739	10,106
115	608	26,515	23,163	21,045	19,536	18,384	23,715	20,717	18,822	17,473	16,443	19,607	17,128	15,562	14,446	13,595	15,519	13,557	12,318	11,435	10,760
115	646	28,124	24,569	22,322	20,722	19,500	25,154	21,974	19,965	18,534	17,441	20,797	18,168	16,506	15,323	14,420	16,461	14,380	13,065	12,129	11,414
115	684	29,730	25,972	23,597	21,905	20,614	26,590	23,229	21,105	19,592	18,437	21,985	19,205	17,449	16,198	15,243	17,401	15,201	13,811	12,821	12,065
115	722	31,586	27,593	25,070	23,273	21,901	28,250	24,679	22,422	20,815	19,588	23,357	20,404	18,538	17,210	16,195	18,488	16,150	14,674	13,622	12,819
115	760	33,203	29,005	26,353	24,464	23,021	29,696	25,942	23,570	21,880	20,590	24,552	21,448	19,487	18,090	17,024	19,434	16,977	15,425	14,319	13,475
138	684	31,593	27,599	25,075	23,278	21,905	28,257	24,684	22,427	20,820	19,592	23,362	20,409	18,542	17,213	16,198	18,492	16,154	14,677	13,625	12,821
138	722	33,565	29,322	26,641	24,731	23,273	30,020	26,225	23,827	22,119	20,815	24,820	21,683	19,700	18,288	17,210	19,646	17,162	15,593	14,475	13,622
138	760	35,283	30,823	28,004	25,997	24,464	31,557	27,567	25,047	23,251	21,880	26,091	22,792	20,708	19,224	18,090	20,651	18,041	16,391	15,216	14,319
138	798	36,998	32,320	29,365	27,260	25,653	33,090	28,907	26,264	24,381	22,944	27,358	23,900	21,714	20,158	18,969	21,655	18,917	17,187	15,955	15,015
138	836	38,709	33,815	30,723	28,521	26,839	34,621	30,244	27,479	25,509	24,005	28,624	25,005	22,719	21,090	19,847	22,657	19,792	17,983	16,694	15,709
138	874	40,418	35,308	32,080	29,780	28,024	36,149	31,579	28,692	26,635	25,065	29,888	26,109	23,722	22,021	20,723	23,657	20,666	18,776	17,430	16,403
138	912	42,124	36,799	33,434	31,037	29,207	37,675	32,913	29,903	27,759	26,123	31,149	27,212	24,723	22,951	21,598	24,655	21,539	19,569	18,166	17,095
138	950	44,104	38,528	35,005	32,496	30,580	39,446	34,459	31,308	29,064	27,350	32,613	28,490	25,885	24,030	22,613	25,814	22,551	20,489	19,020	17,899
138	988	45,819	40,026	36,366	33,759	31,769	40,980	35,799	32,526	30,194	28,414	33,881	29,598	26,892	24,964	23,492	26,818	23,428	21,285	19,760	18,594
185	950	48,630	42,482	38,598	35,831	33,718	43,495	37,996	34,522	32,047	30,157	35,961	31,414	28,542	26,496	24,934	28,464	24,865	22,592	20,972	19,736
185	988	50,521	44,134	40,099	37,224	35,029	45,186	39,473	35,864	33,293	31,330	37,359	32,636	29,652	27,526	25,903	29,570	25,832	23,470	21,788	20,503

** Se considera un rango normal de aplicación entre 4 y 12 m de luz libre. Los valores sobre 12 m (marcados en gris) son sólo referenciales. Bajo 4 m se puede usar MSD Estructural.*

Tabla 9 Hilam Estándar





Luces admisibles (en m) para vigas HILAM, en techos

Inclinación 100% (45º)

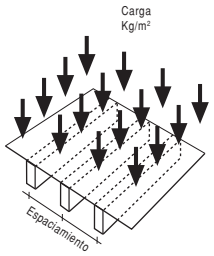
Peso del techo		15 kgf/m²					30 kgf/m²					60 kgf/m²					120 kgf/m²				
Sección		Módulo					Módulo					Módulo					Módulo				
Espesor mm	Altura mm	0,8m	1,2m	1,6m	2,0m	2,40m	0,8m	1,2m	1,6m	2,0m	2,40m	0,8m	1,2m	1,6m	2,0m	2,40m	0,8m	1,2m	1,6m	2,0m	2,40m
42	185	5,256	4,592	4,172	3,873	3,644	4,600	4,018	3,651	3,389	3,189	3,746	3,272	2,973	2,760	2,597	2,945	2,573	2,338	2,170	2,042
42	228	6,567	5,737	5,212	4,839	4,553	5,747	5,020	4,561	4,234	3,985	4,680	4,089	3,715	3,448	3,245	3,680	3,215	2,921	2,712	2,552
42	266	7,640	6,674	6,064	5,629	5,297	6,686	5,841	5,306	4,926	4,636	5,445	4,756	4,321	4,012	3,775	4,281	3,740	3,398	3,154	2,968
65	228	7,596	6,636	6,029	5,597	5,267	6,648	5,807	5,276	4,898	4,609	5,414	4,729	4,297	3,989	3,754	4,257	3,719	3,379	3,136	2,951
65	266	8,837	7,720	7,014	6,511	6,127	7,733	6,756	6,138	5,698	5,362	6,298	5,502	4,999	4,640	4,367	4,952	4,326	3,930	3,649	3,434
65	304	10,070	8,797	7,992	7,419	6,982	8,812	7,698	6,994	6,493	6,110	7,177	6,269	5,696	5,288	4,976	5,643	4,930	4,479	4,158	3,913
90	342	12,626	11,030	10,022	9,303	8,755	11,050	9,653	8,770	8,142	7,662	8,999	7,861	7,142	6,630	6,239	7,076	6,181	5,616	5,213	4,906
90	380	13,990	12,221	11,104	10,308	9,700	12,243	10,696	9,718	9,021	8,489	9,971	8,710	7,914	7,346	6,913	7,840	6,849	6,223	5,777	5,436
90	418	15,348	13,408	12,182	11,309	10,642	13,432	11,734	10,661	9,897	9,313	10,939	9,556	8,682	8,060	7,584	8,601	7,514	6,827	6,337	5,964
90	456	16,703	14,591	13,257	12,307	11,581	14,617	12,769	11,602	10,770	10,135	11,904	10,399	9,448	8,771	8,254	9,360	8,177	7,429	6,897	6,490
90	494	18,256	15,948	14,490	13,451	12,658	15,976	13,957	12,680	11,772	11,077	13,011	11,366	10,327	9,586	9,021	10,230	8,937	8,120	7,538	7,093
90	532	19,623	17,142	15,575	14,458	13,606	17,173	15,002	13,630	12,653	11,907	13,985	12,217	11,100	10,304	9,697	10,997	9,606	8,728	8,102	7,625
90	570	20,985	18,332	16,656	15,462	14,550	18,365	16,043	14,576	13,532	12,734	14,956	13,065	11,871	11,020	10,370	11,760	10,273	9,334	8,665	8,154
115	456	18,125	15,833	14,386	13,354	12,567	15,862	13,857	12,589	11,687	10,998	12,917	11,284	10,253	9,518	8,956	10,157	8,873	8,062	7,484	7,043
115	494	19,810	17,306	15,723	14,596	13,735	17,337	15,145	13,760	12,774	12,021	14,118	12,334	11,206	10,403	9,789	11,101	9,698	8,811	8,180	7,697
115	532	21,293	18,601	16,901	15,689	14,764	18,635	16,279	14,791	13,730	12,921	15,176	13,257	12,045	11,182	10,522	11,933	10,424	9,471	8,792	8,274
115	570	22,772	19,893	18,074	16,778	15,789	19,929	17,409	15,817	14,684	13,818	16,229	14,178	12,881	11,958	11,253	12,761	11,148	10,129	9,403	8,848
115	608	24,247	21,182	19,245	17,865	16,812	21,220	18,537	16,842	15,635	14,713	17,281	15,096	13,716	12,732	11,982	13,588	11,870	10,785	10,012	9,421
115	646	25,718	22,467	20,412	18,949	17,832	22,507	19,662	17,864	16,583	15,606	18,329	16,012	14,548	13,505	12,709	14,412	12,590	11,439	10,619	9,993
115	684	27,187	23,750	21,578	20,032	18,850	23,793	20,785	18,884	17,531	16,497	19,376	16,927	15,379	14,276	13,435	15,236	13,309	12,092	11,226	10,564
115	722	28,884	25,233	22,925	21,282	20,027	25,278	22,082	20,063	18,625	17,527	20,586	17,983	16,339	15,168	14,273	16,187	14,140	12,847	11,926	11,223
115	760	30,362	26,524	24,099	22,371	21,052	26,572	23,212	21,090	19,578	18,424	21,639	18,903	17,175	15,944	15,004	17,015	14,864	13,505	12,537	11,798
138	684	28,890	25,238	22,930	21,287	20,032	25,283	22,087	20,067	18,629	17,531	20,590	17,987	16,342	15,171	14,276	16,190	14,143	12,850	11,929	11,226
138	722	30,694	26,814	24,362	22,616	21,282	26,862	23,466	21,320	19,792	18,625	21,876	19,110	17,363	16,118	15,168	17,201	15,026	13,652	12,674	11,926
138	760	32,265	28,186	25,609	23,773	22,371	28,237	24,667	22,411	20,805	19,578	22,995	20,088	18,251	16,943	15,944	18,081	15,795	14,351	13,322	12,537
138	798	33,833	29,556	26,854	24,929	23,459	29,609	25,866	23,501	21,816	20,530	24,113	21,065	19,138	17,766	16,719	18,960	16,563	15,049	13,970	13,146
138	836	35,397	30,923	28,095	26,081	24,543	30,978	27,062	24,587	22,825	21,479	25,228	22,038	20,023	18,588	17,492	19,837	17,329	15,744	14,616	13,754
138	874	36,961	32,288	29,336	27,233	25,627	32,346	28,257	25,673	23,833	22,428	26,342	23,012	20,908	19,409	18,265	20,713	18,094	16,440	15,261	14,362
138	912	38,521	33,651	30,574	28,382	26,709	33,711	29,450	26,757	24,839	23,374	27,453	23,983	21,790	20,228	19,035	21,587	18,858	17,134	15,905	14,968
138	950	40,331	35,232	32,011	29,716	27,964	35,296	30,834	28,014	26,006	24,473	28,744	25,110	22,814	21,179	19,930	22,601	19,744	17,939	16,653	15,671
138	988	41,899	36,602	33,255	30,872	29,051	36,668	32,032	29,103	27,017	25,424	29,861	26,086	23,701	22,002	20,705	23,480	20,512	18,636	17,300	16,280
185	950	44,376	38,766	35,221	32,696	30,769	38,836	33,926	30,824	28,614	26,927	31,627	27,628	25,102	23,303	21,929	24,868	21,724	19,738	18,323	17,243
185	988	46,104	40,276	36,593	33,970	31,967	40,348	35,247	32,024	29,729	27,976	32,858	28,704	26,080	24,210	22,783	25,837	22,571	20,507	19,037	17,914

** Se considera un rango normal de aplicación entre 4 y 12 m de luz libre. Los valores sobre 12 m (marcados en gris) son sólo referenciales. Bajo 4 m se puede usar MSD Estructural.*

Altura mínima de la sección de elementos Hilam Estándar (mm), para densidades de carga y luces en aplicaciones de piso y techo

Flechas máximas admisibles: Techos L/200, Pisos L/300

Densidad de carga	Espesor	Techos horizontales luz (m)								Pisos livianos luz (m)							
Kg f/m	mm	5	6	7	8	9	10	11	12	5	6	7	8	9	10	11	12
125	42	266								266							
125	65	228	228	304						266	304						
125	90				342	342	380	418	456			342	342	380	418	456	494
125	115																456
125	138																
125	185																
250	42																
250	65	266	304							304							
250	90			342	380	418	456	532	570		342	380	418	494	532	570	
250	115							494	532						494	532	608
250	138																
250	185																
375	65																
375	90	342	342	380	456	494	532			342	380	418	494	532			
375	115						494	532	608					494	570	608	684
375	138																
375	185																
500	65																
500	90	342	380	456	494	570				342	418	494	570				
500	115					494	570	608	684				494	570	608	684	760
500	138																
500	185																
625	65																
625	90	342	418	494	570					456	532						
625	115				494	570	608	646	760			494	570	608	684	722	
625	138																760
625	185																
750	65																
750	90	418	532							494	570						
750	115			494	532	608	684	760			456	532	608	684	760		
750	138								760							760	836
750	185																
875	65																
875	90	456	570							532							
875	115			532	570	646	684			456	570	646	722				
875	138							722	798					684	760	836	874
875	185																
1.000	65																
1.000	90	494								570							
1.000	115		532	608	684					494	608	684					
1.000	138					684	722	798	836				722	798	874	988	
1.000	185																950



Densidad de Carga = $\frac{\text{carga}}{\text{espaciamiento}}$