

GRUPO DE PESQUISA



Estruturas metálicas: detalhes

Programa de Pós-graduação em Arquitetura e Urbanismo
Universidade Presbiteriana Mackenzie
novembro de 2021

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GRUPO DE PESQUISA



Esta coletânea de detalhes construtivos e informações sobre os tipos de junções de estruturas metálicas estão referenciados para que o pesquisador possa recorrer às fontes.

Para cada caso o projetista seleciona a forma da estrutura de acordo com várias condicionantes:

Intenção plástica;

Acesso ao produto e à mão de obra;

Custos;

Tempo de obra;

Localização da obra;

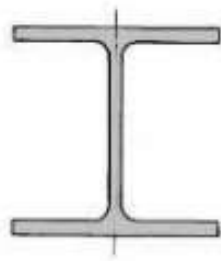
Desempenho dos sistemas.



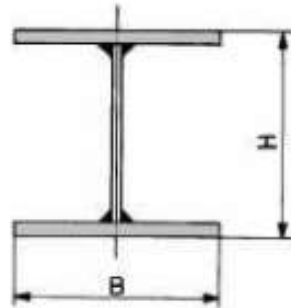
Mackenzie

Perfis para colunas

A escolha das colunas para edifícios é feita em função da compressão. Perfis que possuam inércia significativa em relação ao eixo de menor inércia (casos dos perfis "H").



PERFIL LAMINADO
HPL, HPM OU HPP
PADRÃO EUROPEU



PERFIL SOLDADO
CS (H = B)



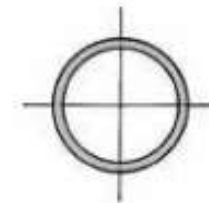
PERFIL LAMINADO
H101,6, H127 E
H152,4 mm
PADRÃO AMERICANO



PERFIL I LAMINADO
REFORÇADO



PERFIL DE SEÇÃO
CAIXÃO



PERFIL TUBULAR

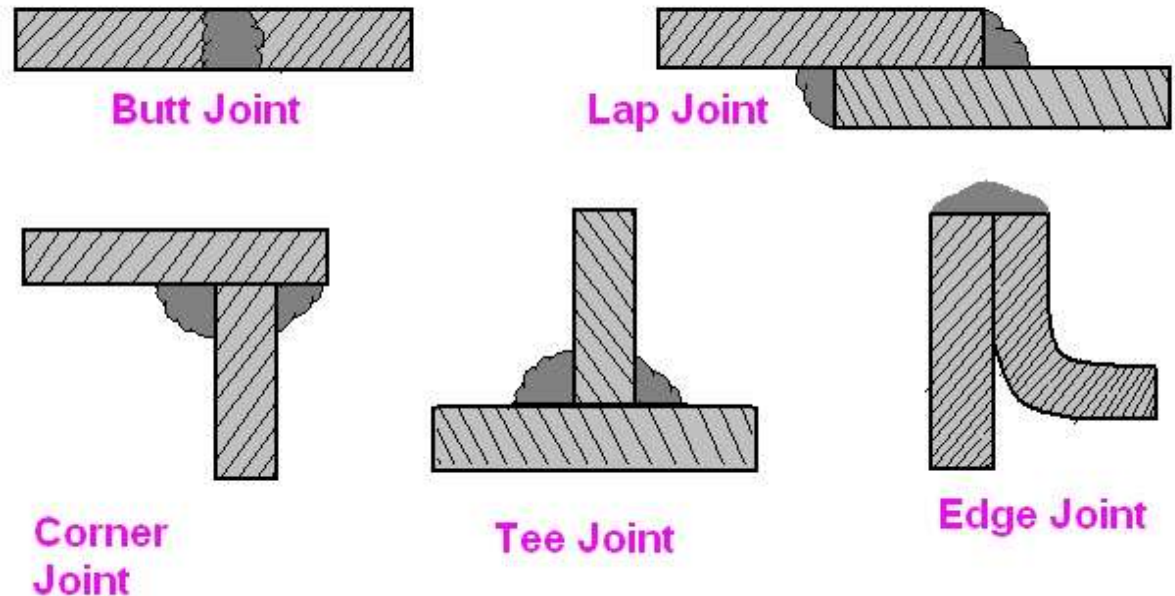


https://www2.gerdau.com.br/produ-tos/perfis-estruturais-de-aco-i-e-h?gclid=CjwKCAjw7--KBhAMEiwAxfpkWH0Ssq8vHm3x9E91maSy7q1vG7MzDyPsJpkXDoX96J24Si9xCD5i4RoCQdMQAvD_BwE

SOLDAS

- As conexões soldadas têm a vantagem principal de serem **simples** no projeto, exigindo menos peças e materiais. As soldas, entretanto, “**encolhem**”, e esse efeito precisa ser considerado no projeto, especialmente para grandes soldas. Além disso, a inspeção de soldas é **mais difícil** e, portanto, mais cara e de manutenção onerosa.

Welding Joints



<http://engineeringhut.blogspot.com/2010/11/welding-and-its-classification.html>

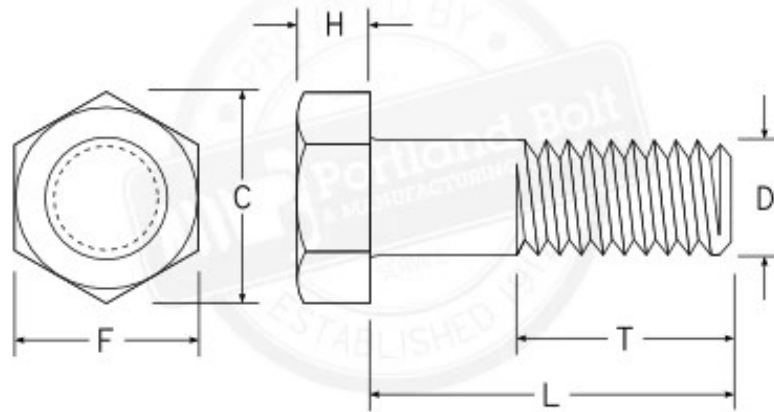
Tabela 5 – Exemplos da simbologia de soldagem.

Significado	Representação 1	Representação 2

<http://site.ufvjm.edu.br/icet/files/2016/07/ligacoes-cbca-1.pdf>

Tabela 5 – Exemplos da simbologia de soldagem (continuação)

		-
		-
		-



- Os **parafusos** substituíram os rebites devido ao seu menor custo de instalação, controle de qualidade, facilidade de instalação e manutenção. Os dois tipos de parafusos comumente usados na construção de aço incluem aço estrutural de alta resistência subdivididos em A325 (Grupo A) e A490 (Grupo B) e são de alta resistência.
- Os parafusos, entretanto, têm a desvantagem de se afrouxar sob cargas vibratórias, resultando em uma redução da resistência.

<https://boulonseclair.com/blogs/technical-literature/how-to-determine-a325-a490-structural-bolt-length-structural-bolts-dimensions>

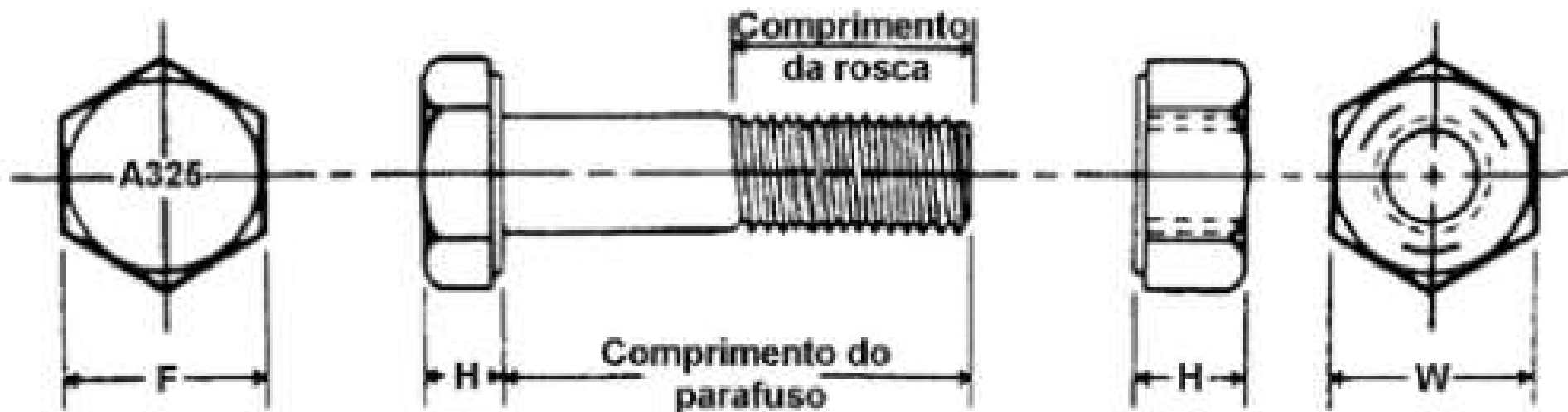
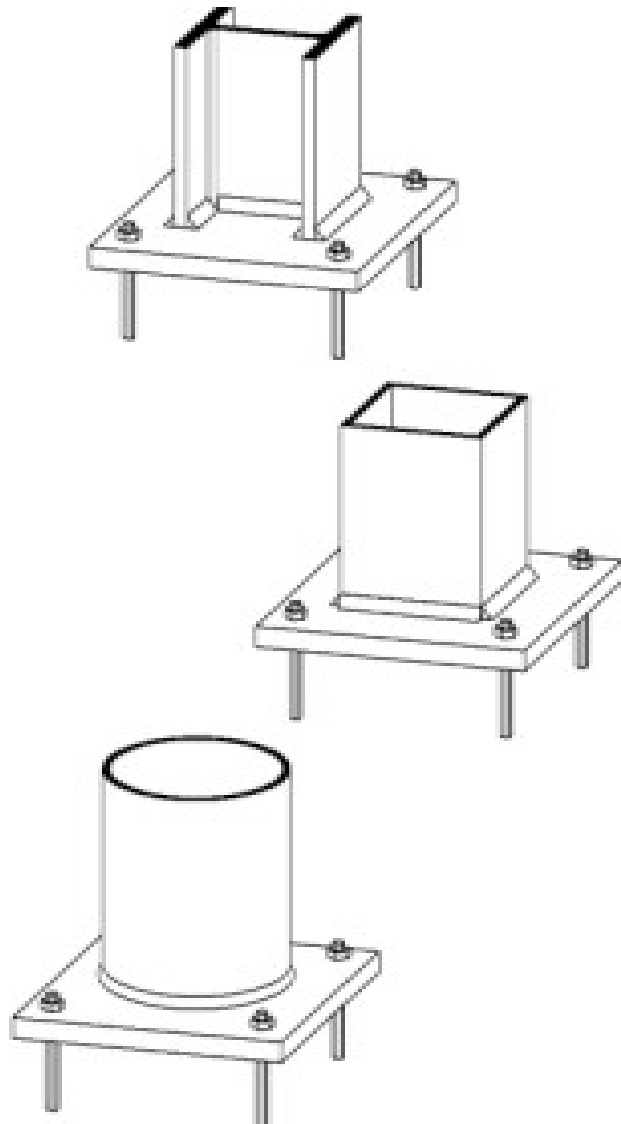


Figura 5 – Parafuso de alta resistência.

Instituto Aço Brasil. Ligações em estruturas metálicas. Volume 1 / Instituto Aço Brasil, Alexandre Luiz Vasconcellos(rev.). - Rio de Janeiro: Instituto Aço Brasil /CBCA, 2011. Edição revisada e atualizada. Disponível em: <http://site.ufvjm.edu.br/icet/files/2016/07/ligacoes-cbca-1.pdf>

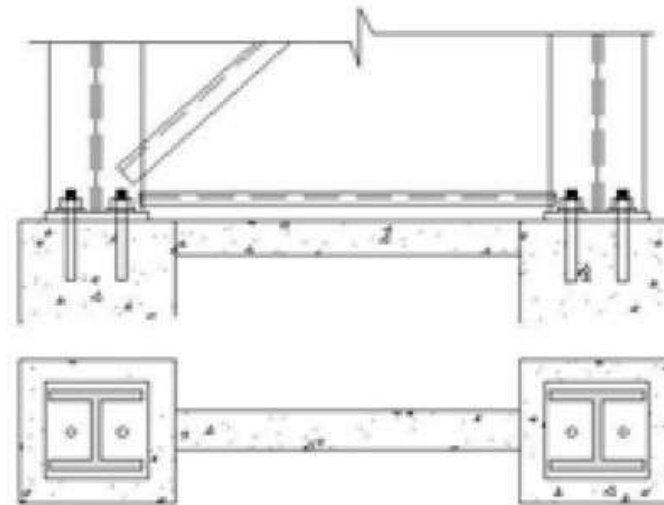
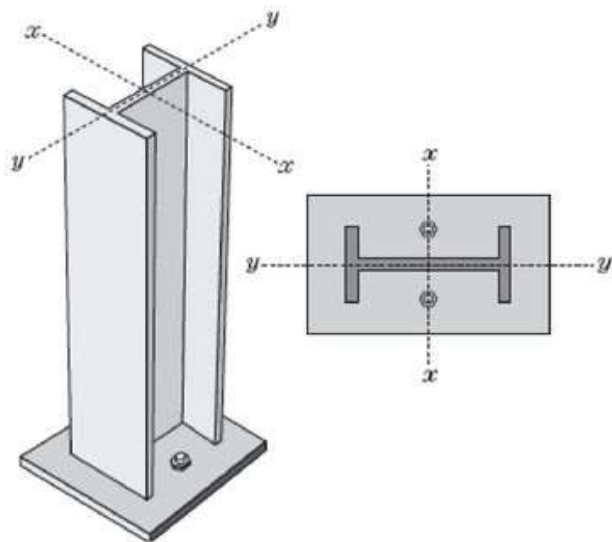
Encontro pilar x fundação

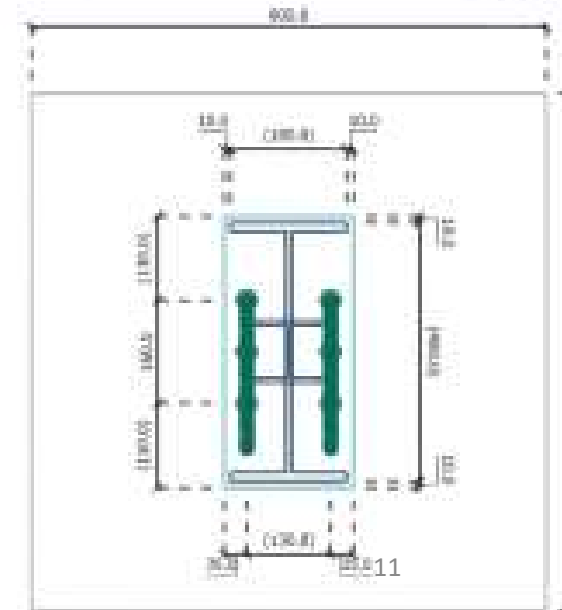
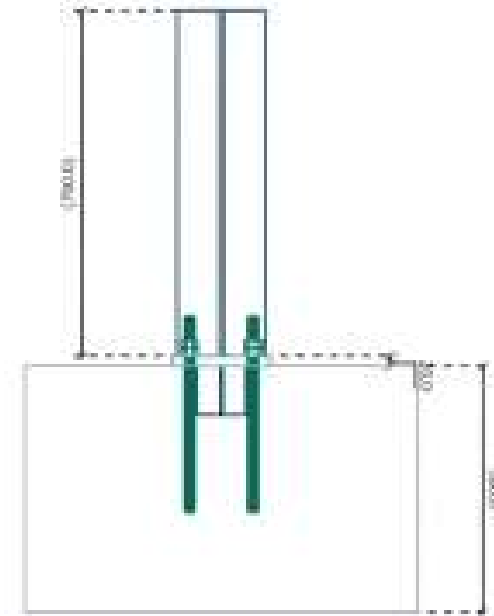
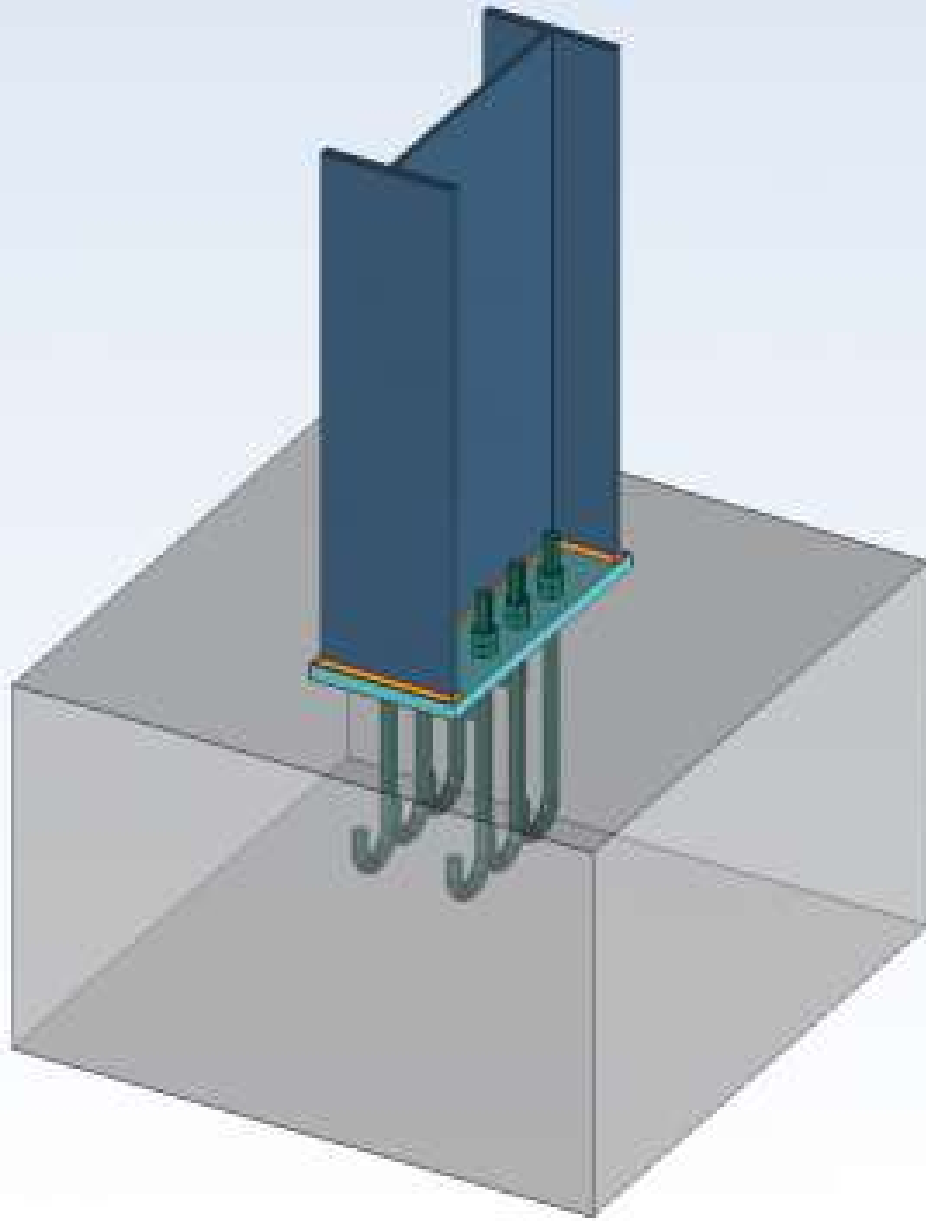


Base de pilares

- Placas de Base

- Tipos de bases





Base plate

Editable

1. Thickness: 10.0 mm

2. Width: 200.0 mm

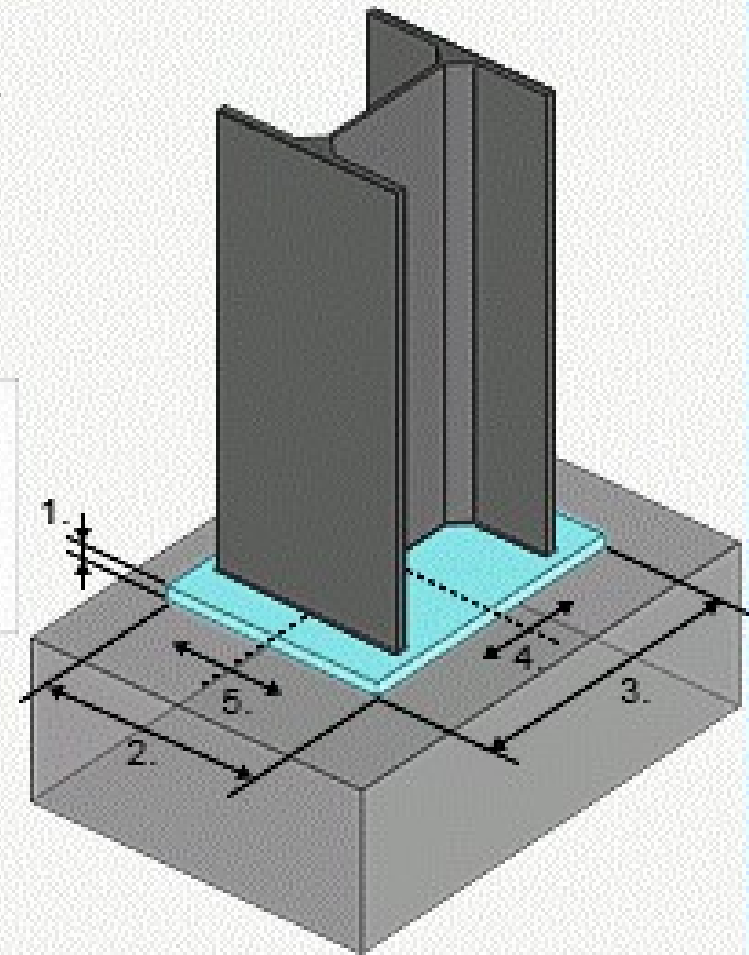
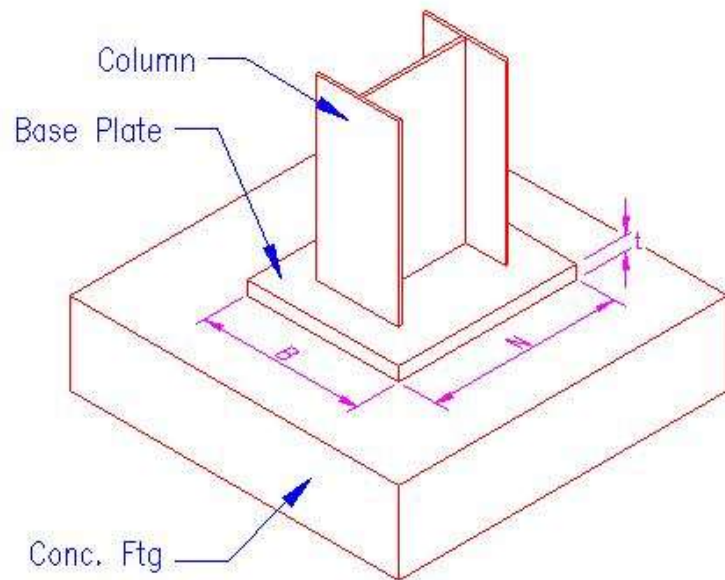
3. Height: 200.0 mm

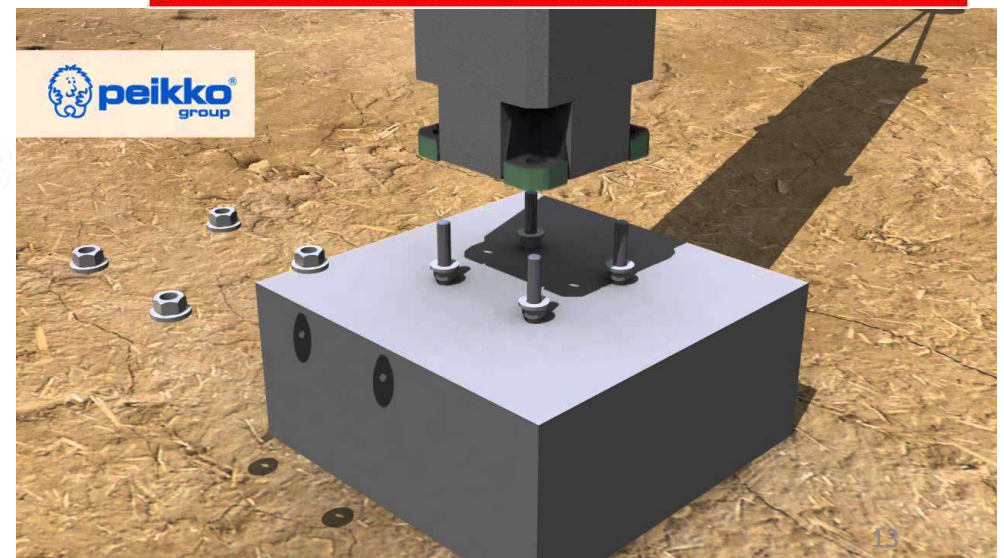
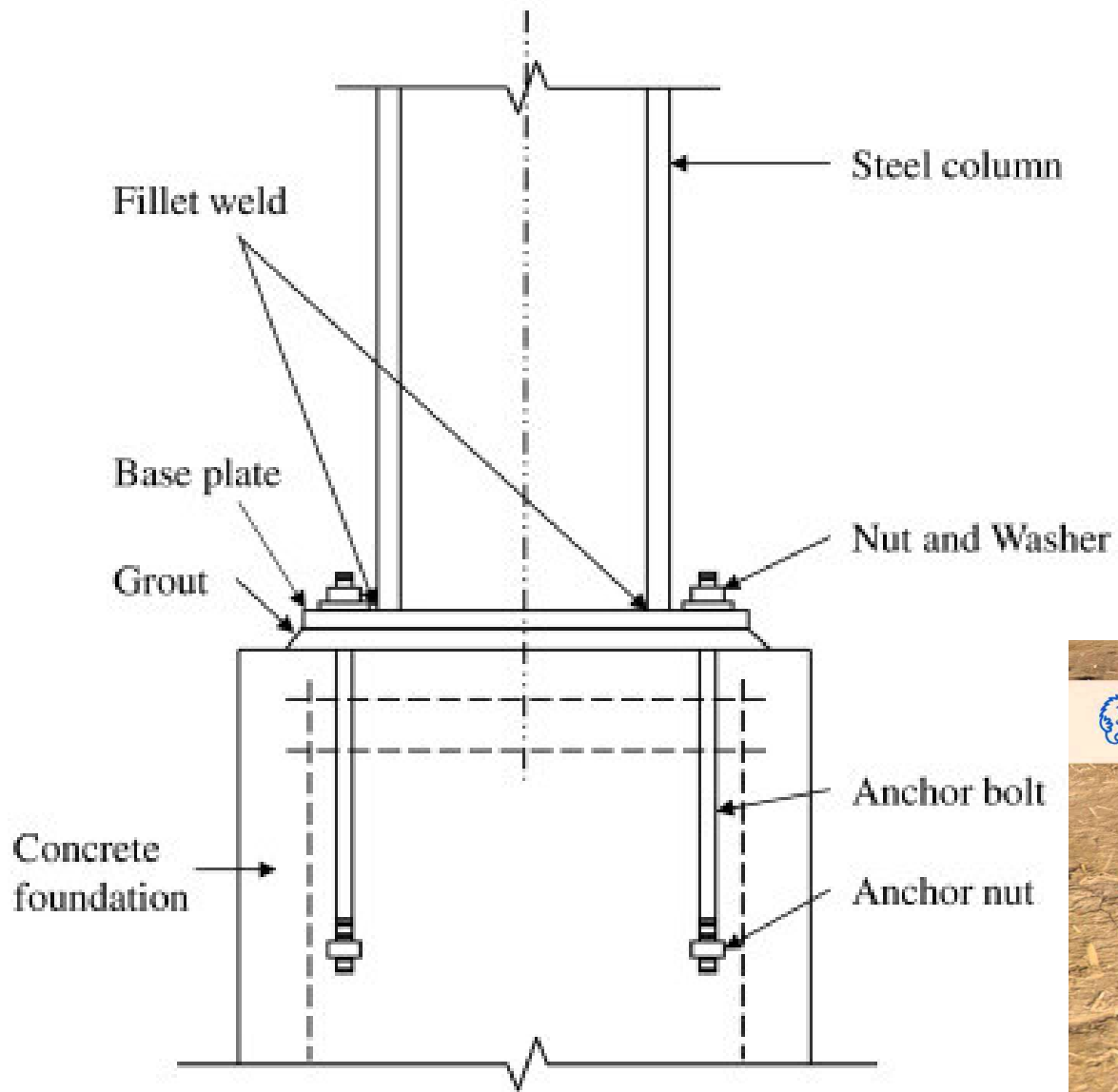
4. Vert. offset: 0.0 mm

Absolute value

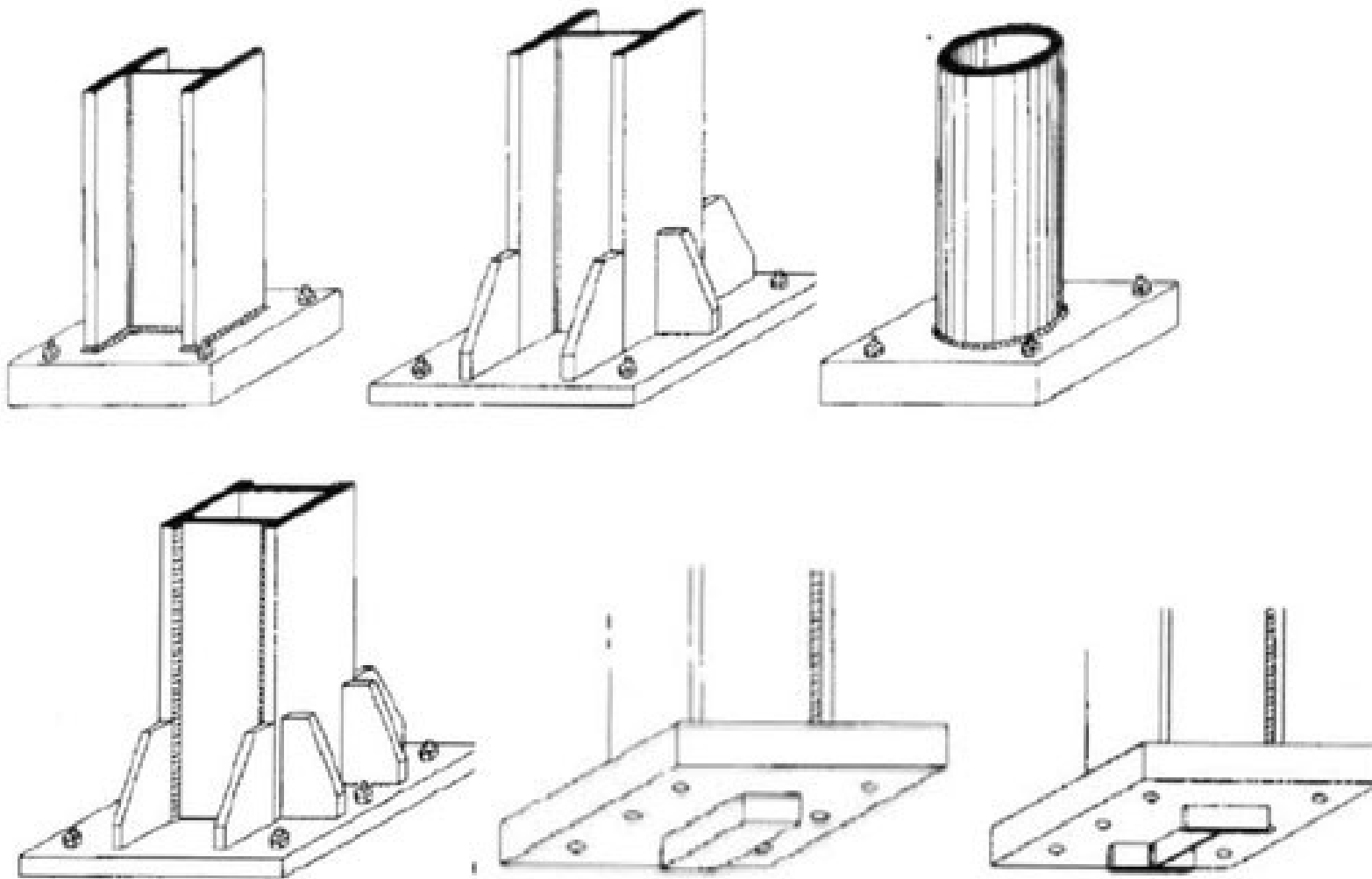
Relative to anchors

Relative to column





<https://www.mec-engineering-spreadsheets.com/documentation-area/steel-framework-joints/>



<https://www.graitec.com/faq-item/faq-2379-what-are-the-available-calculated-steel-c/>

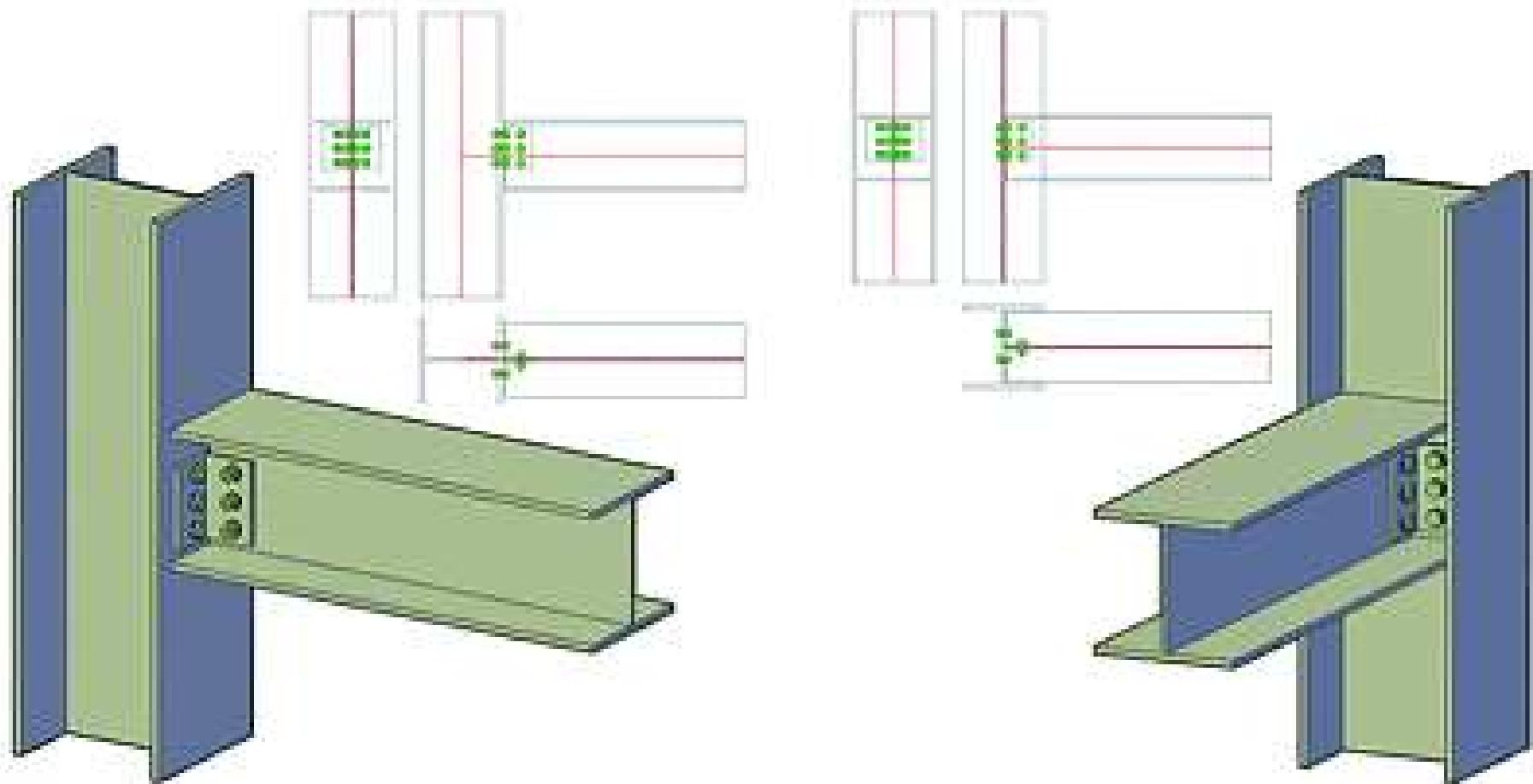


Fig. 9 *Clip Angle* joint from the Beam to Column category

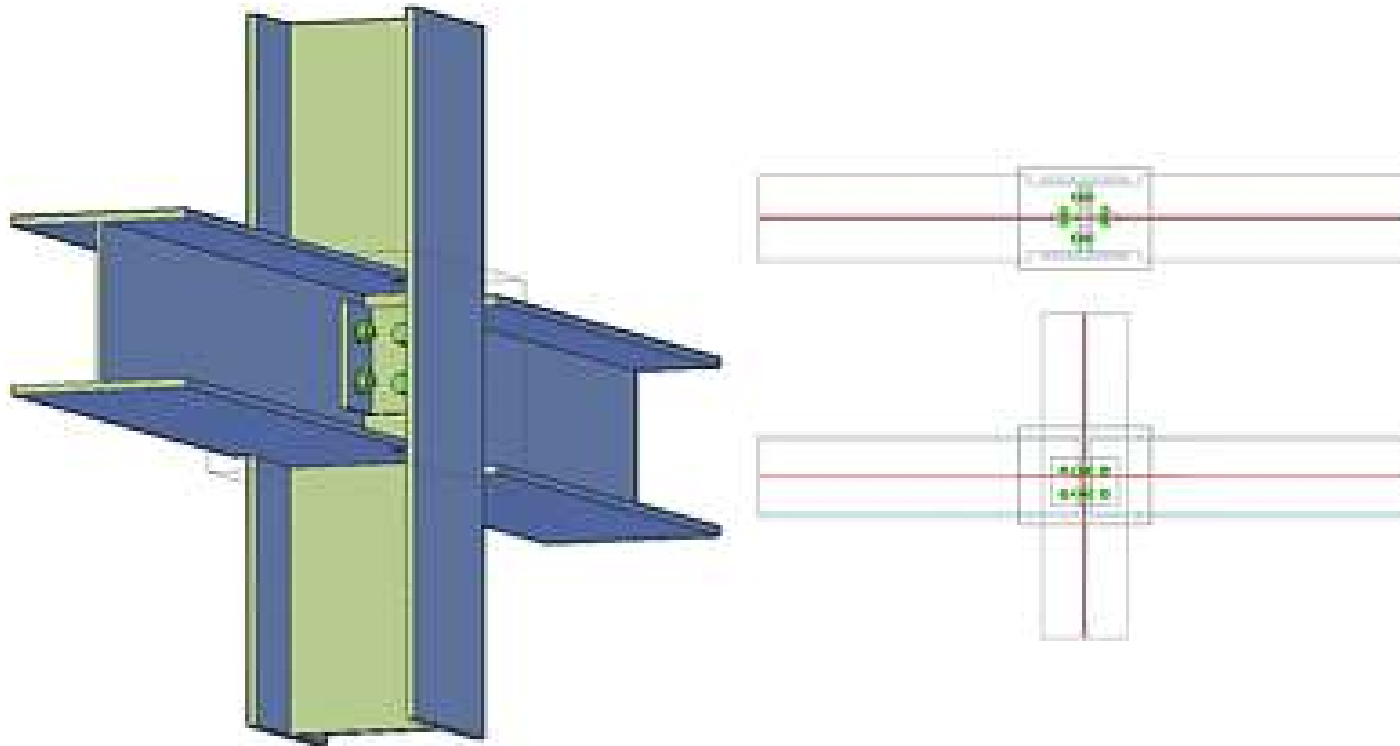


Fig. 11 *Double Side Clip Angle* joint from the **Beam to Column** category

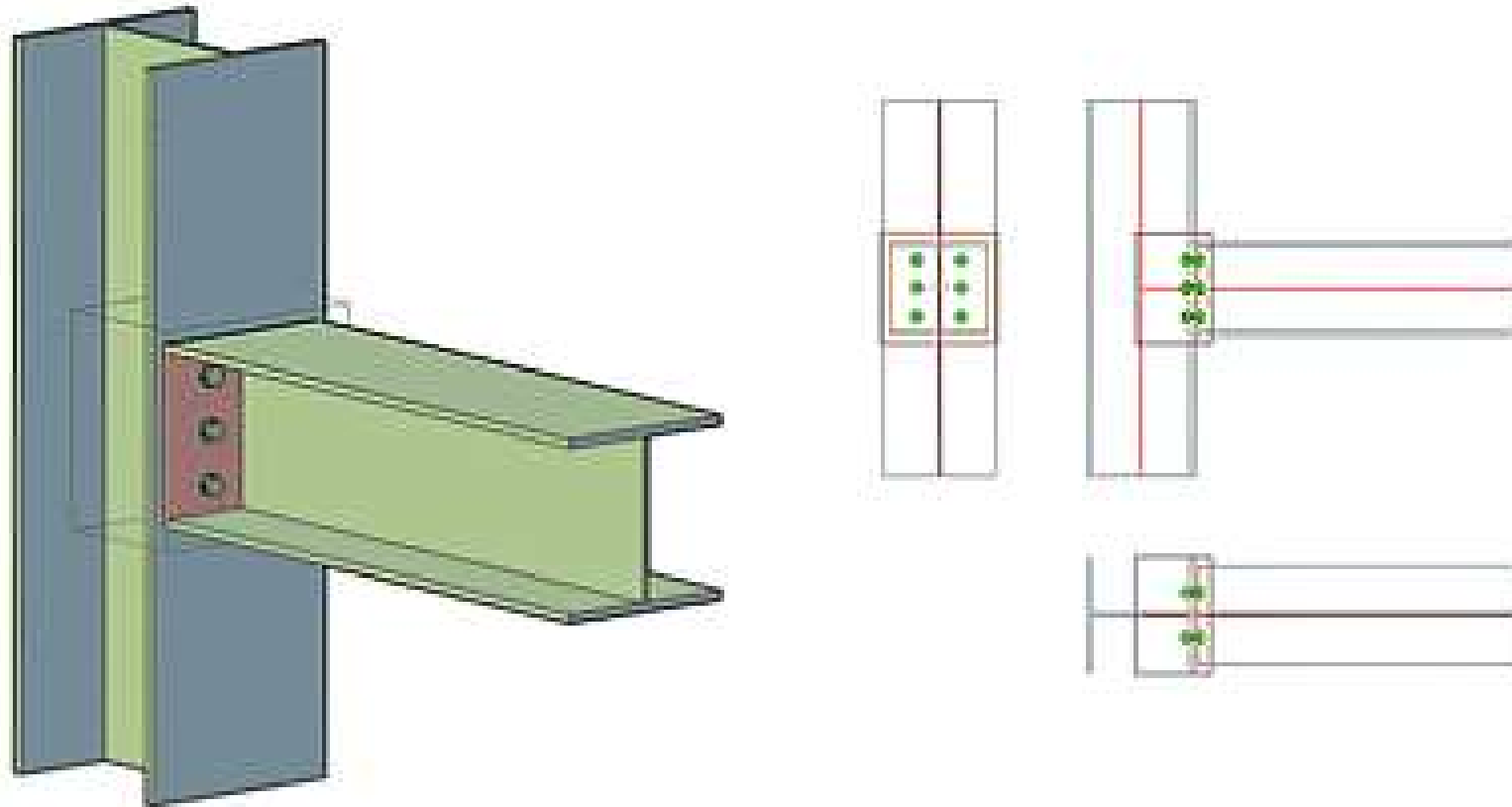
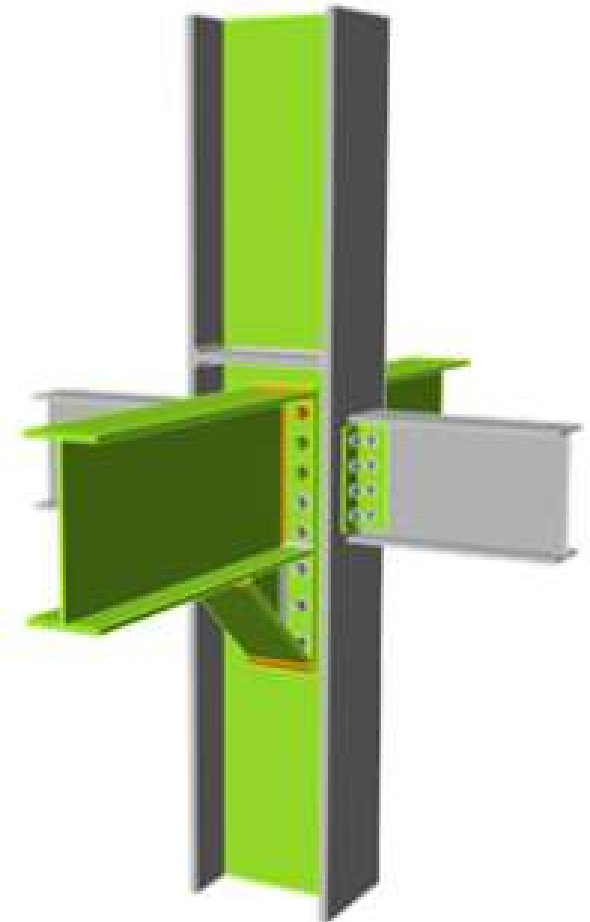
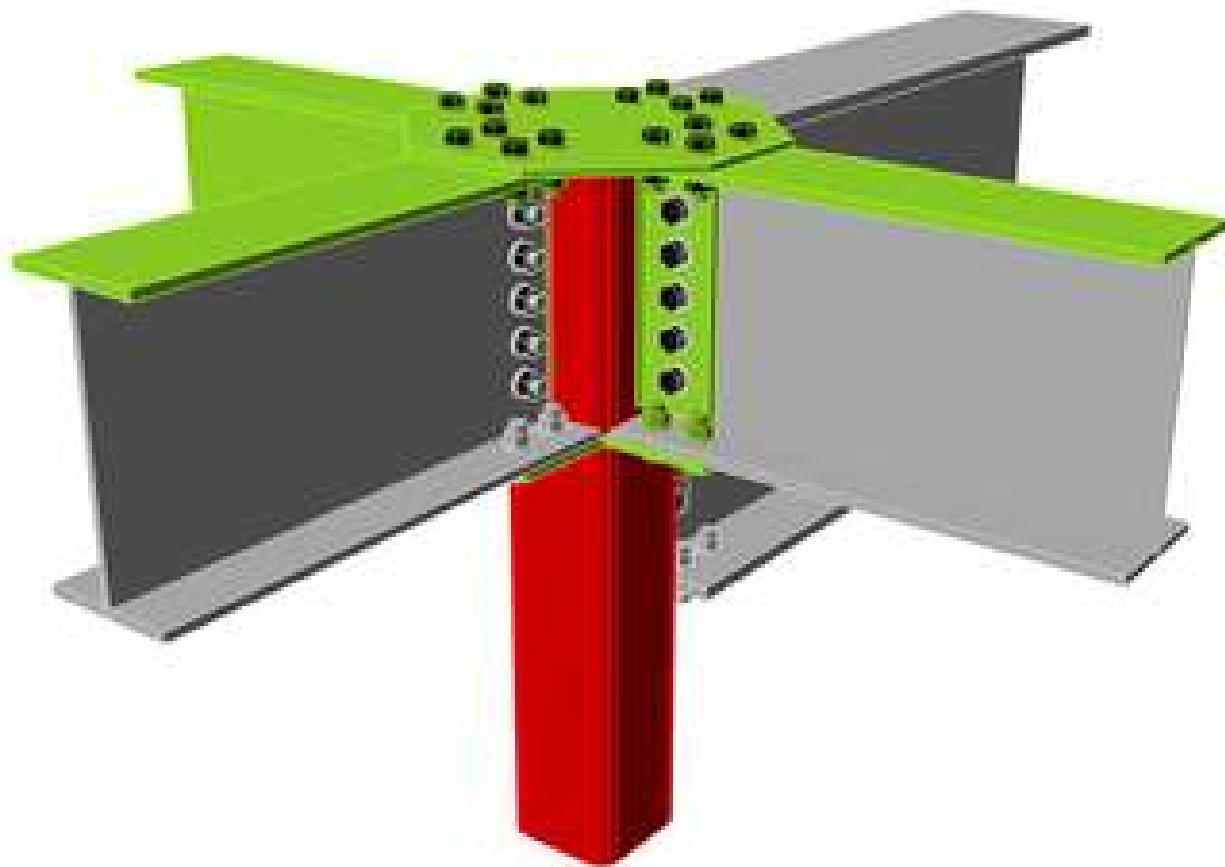
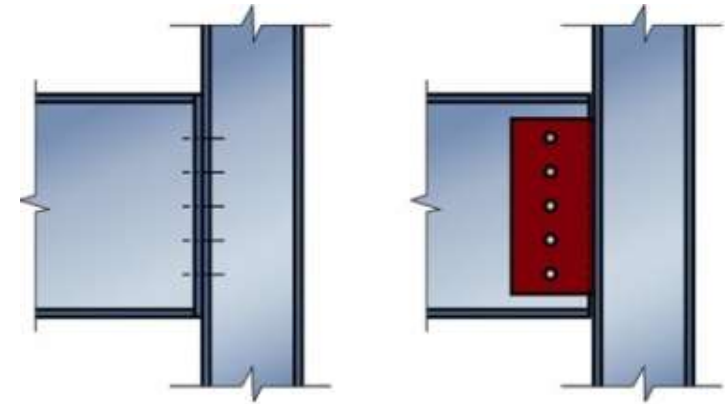
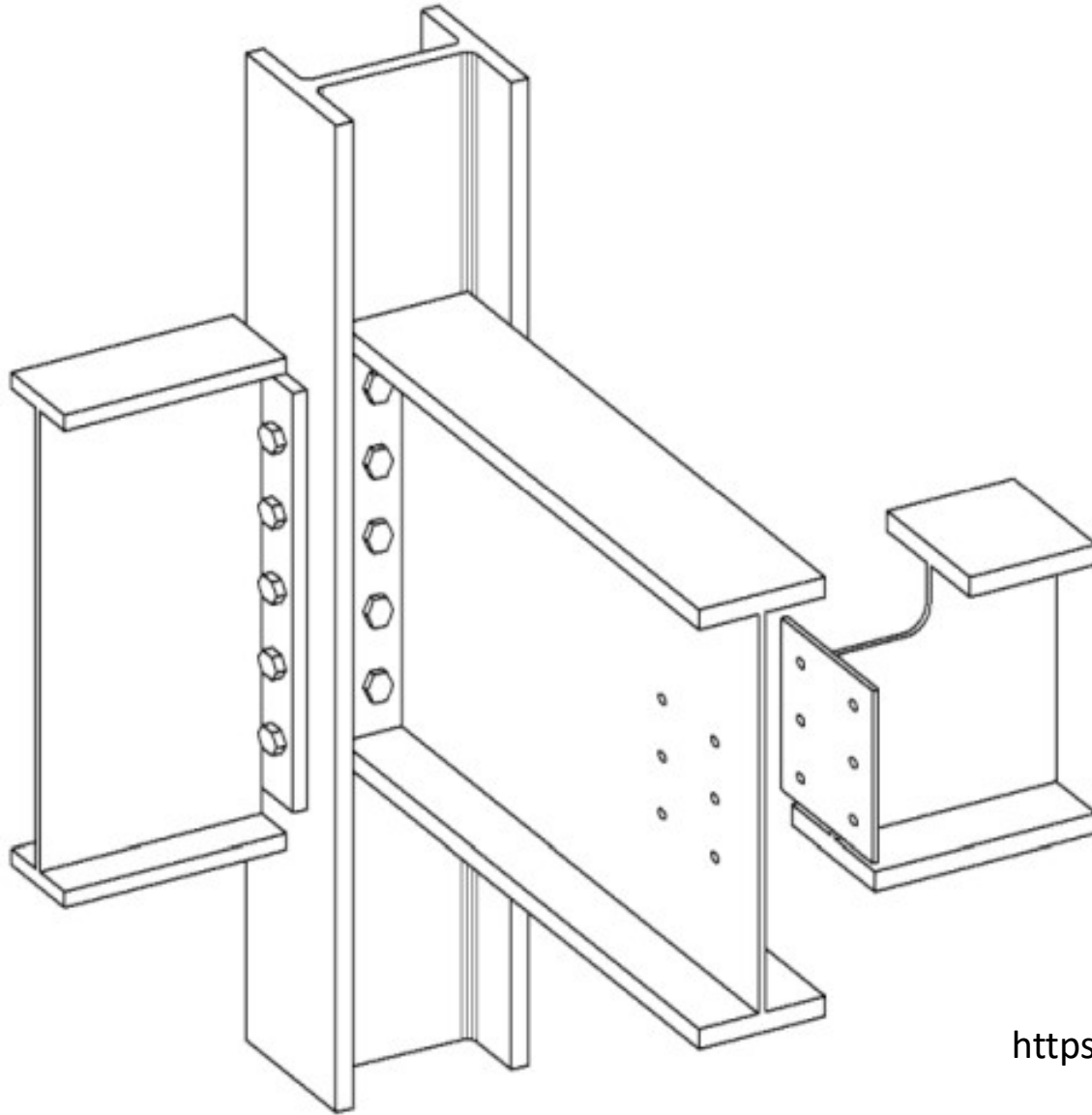


Fig. 13 *Moment End Plate* joint from the **Beam to Column** category

<https://www.ideastatica.com/steel-old>



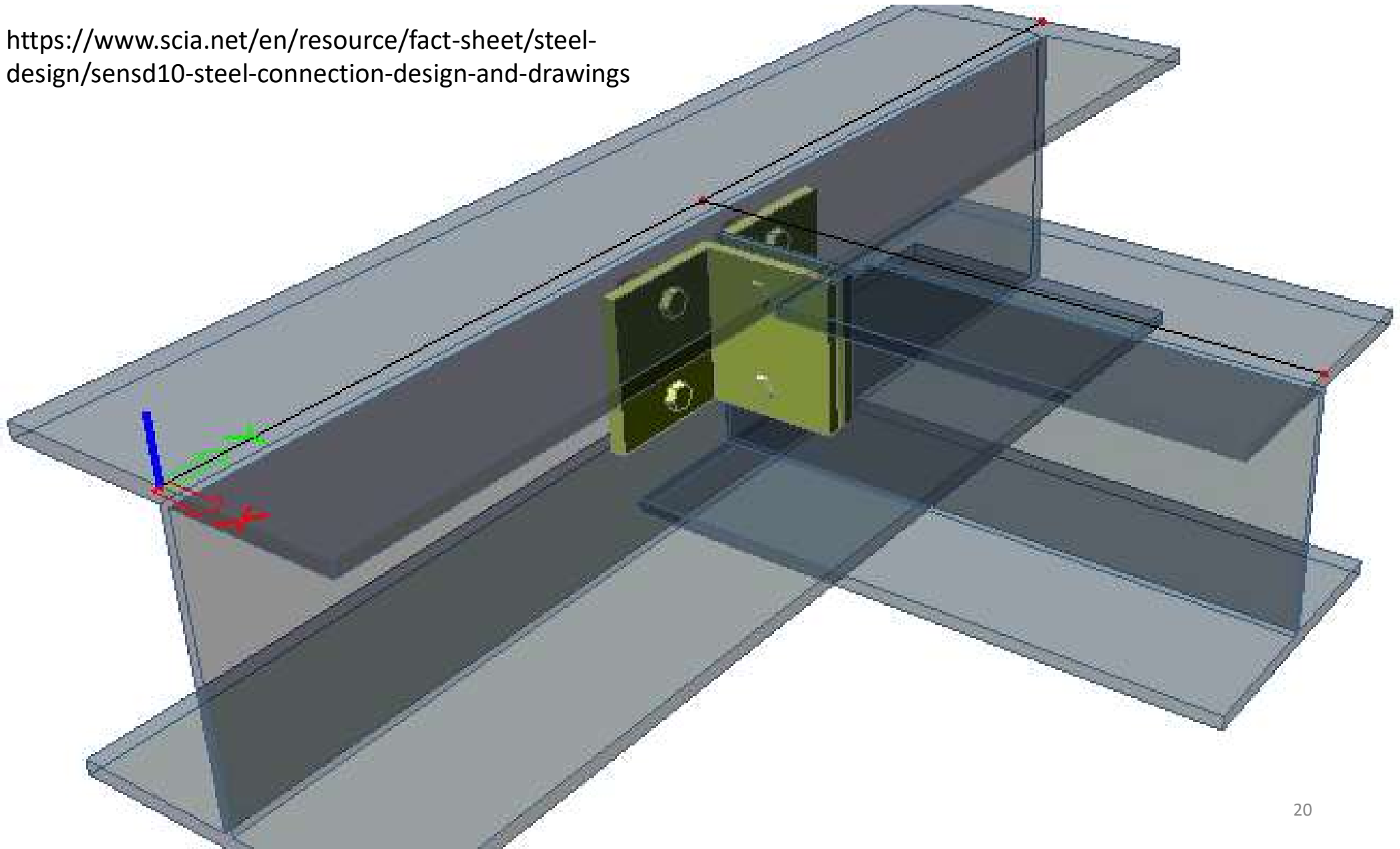


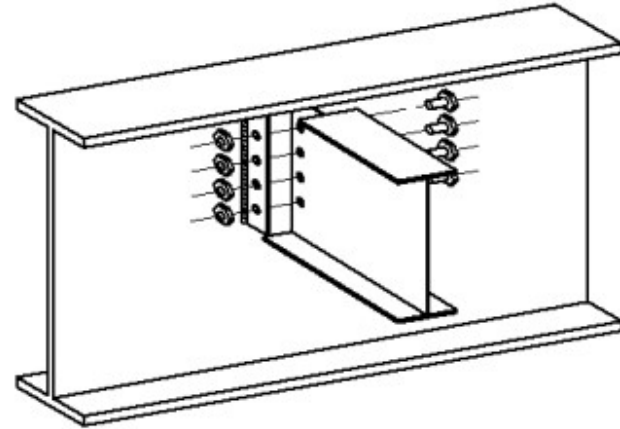
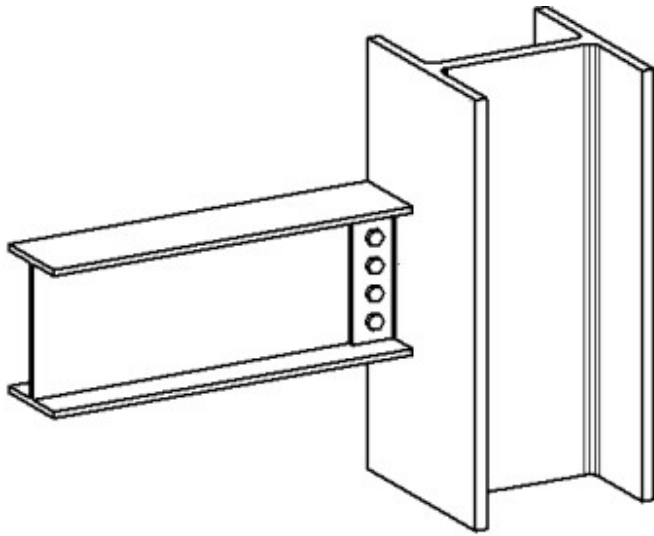
Flexible end plate

Fin plate

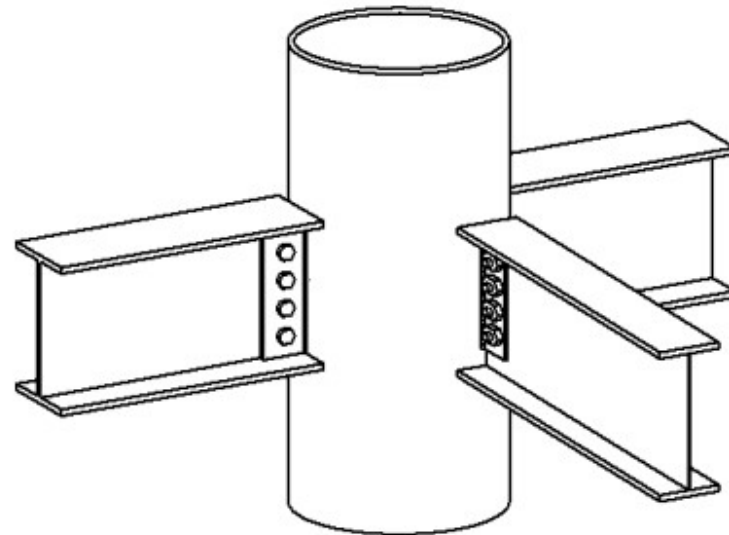
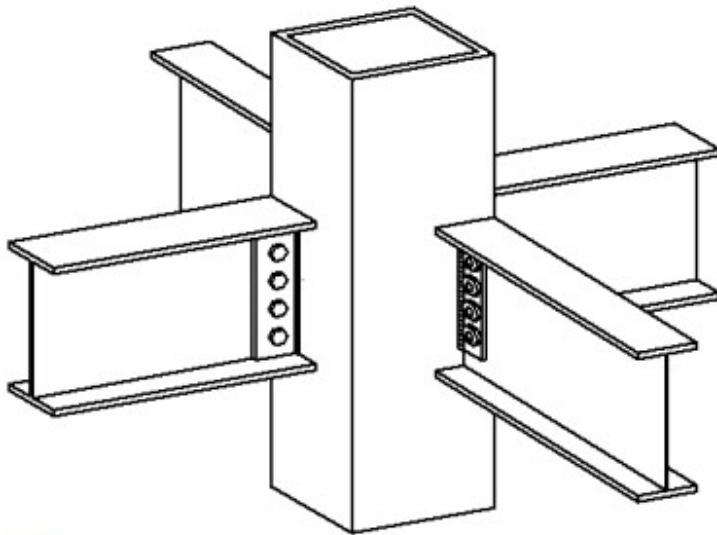
https://www.steelconstruction.info/Simple_connections

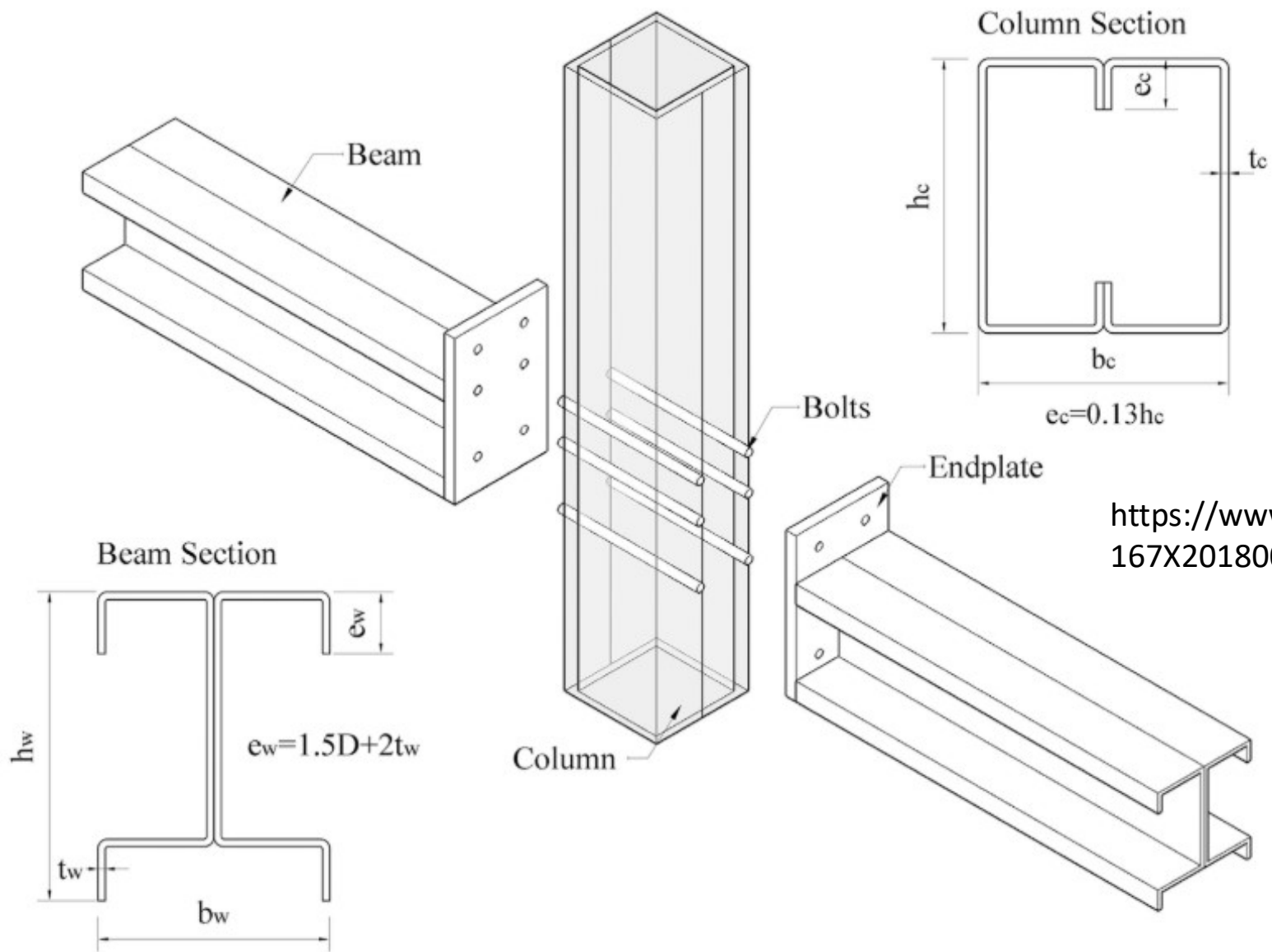
<https://www.scia.net/en/resource/fact-sheet/steel-design/sensd10-steel-connection-design-and-drawings>





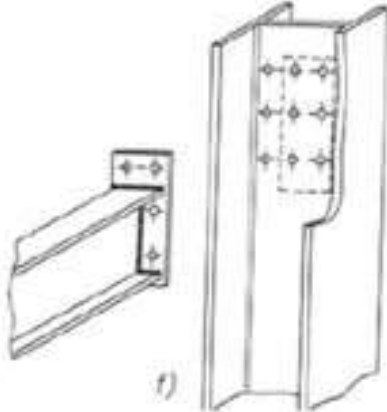
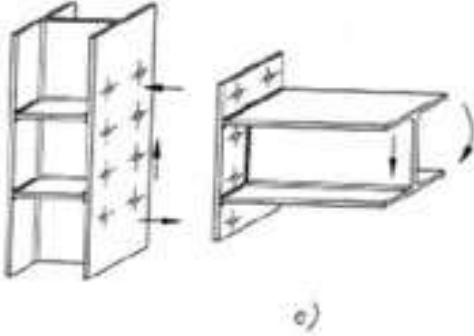
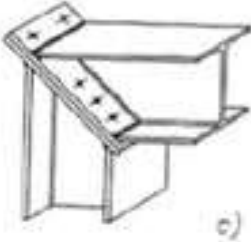
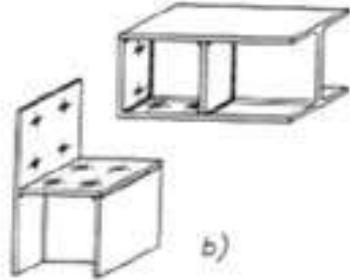
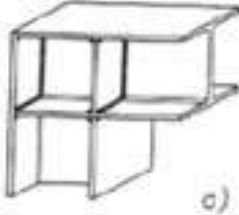
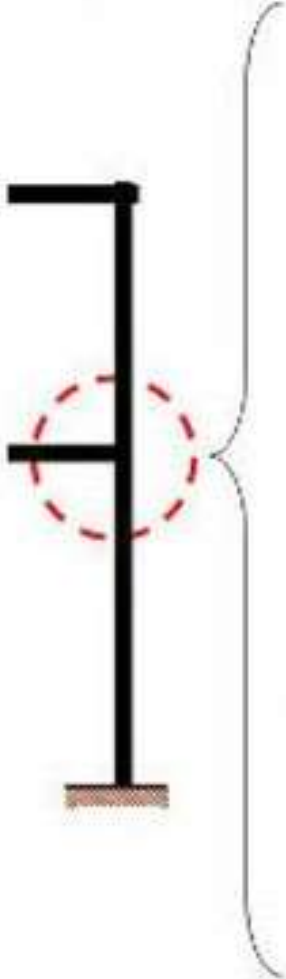
https://www.steelconstruction.info/Simple_connections





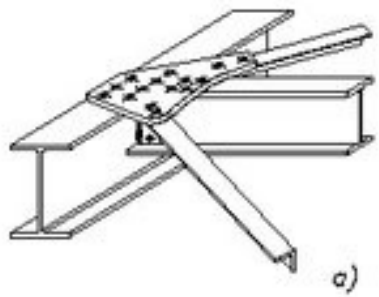
https://www.scielo.br/scielo.php?pid=S2448-167X2018000400497&script=sci_arttext

<https://www.mec-engineering-spreadsheets.com/documentation-area/steel-framework-joints/>

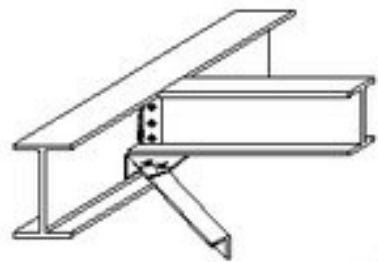


Contraventamentos

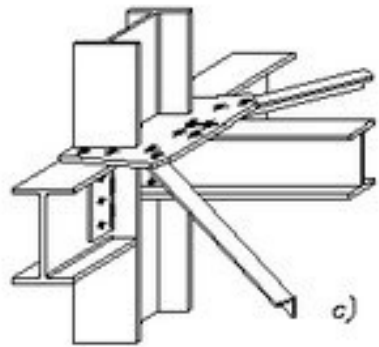
- São compostos por barras adicionadas às estruturas com a finalidade de minimizar ou impedir deslocamentos horizontais.
- São empregados para fornecer estabilidade às estruturas que sofrem ação do vento e de outras intempéries que geram forças horizontais.
- Podem ser utilizados na vertical (travamento de vigas e pilares) ou na horizontal (travamento de coberturas).



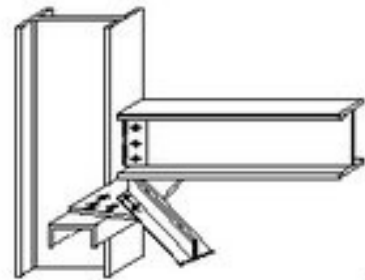
a)



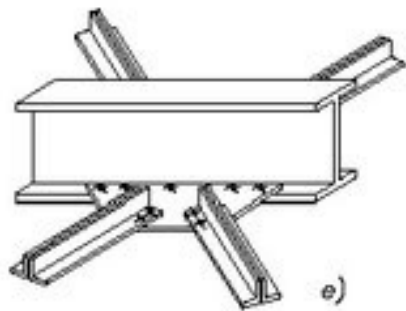
b)



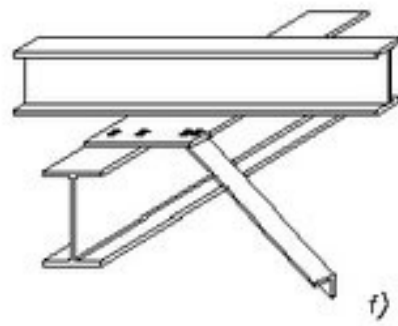
c)



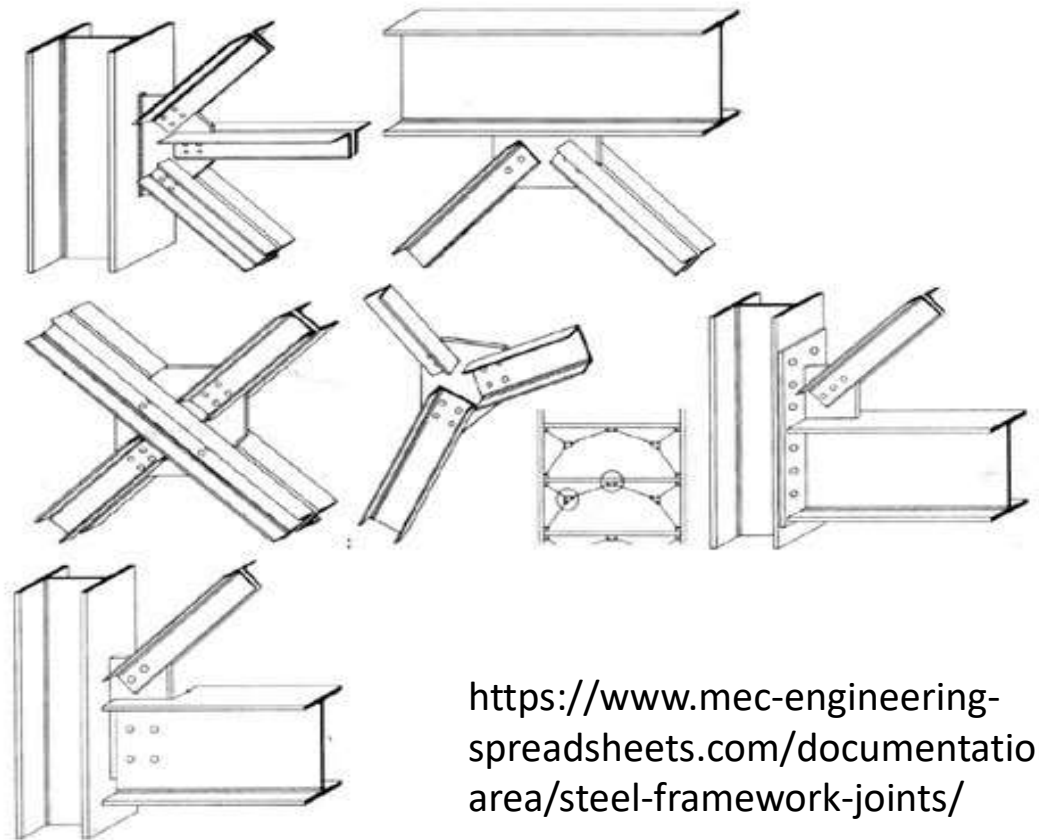
d)



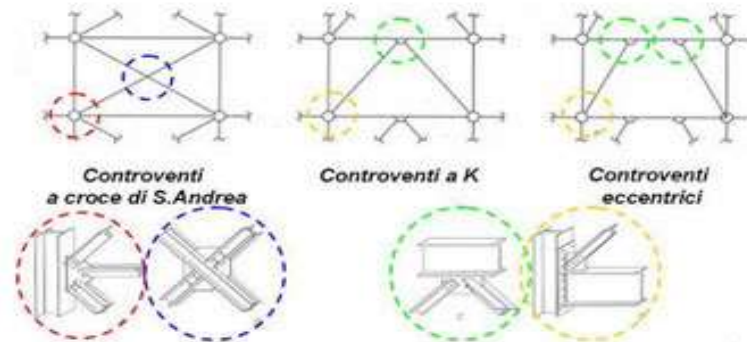
e)

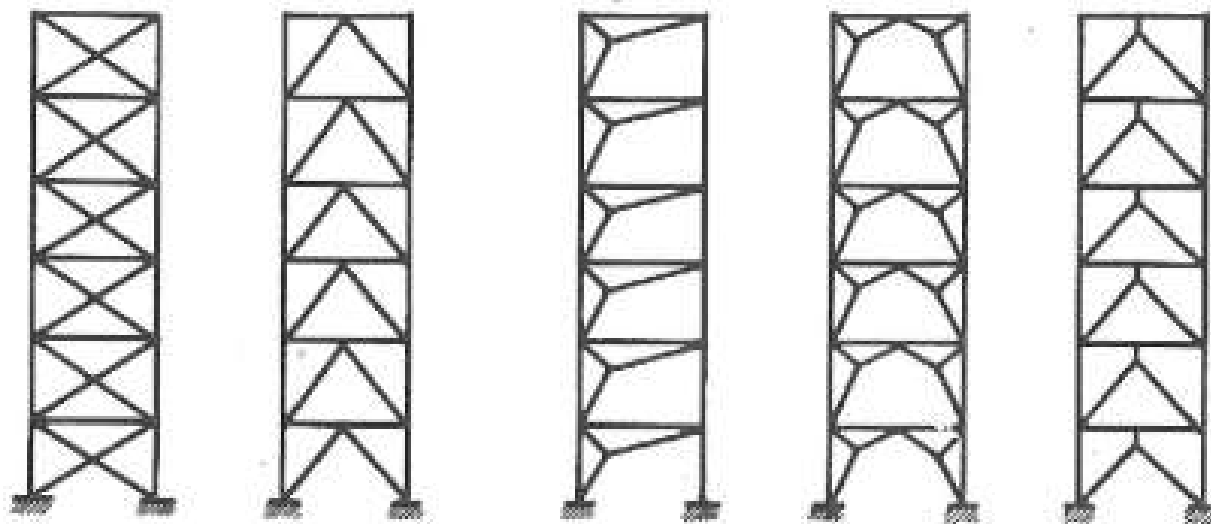


f)



<https://www.mec-engineering-spreadsheets.com/documentation-area/steel-framework-joints/>





CHAVES, José R.F. Análise dinâmica de pórticos metálicos contaventados. Dissertação (mestrado) UNB, Brasília, 2009
<http://www.pecc.unb.br/wp-content/uploads/dissertacoes/M09-8A-Jos%C3%A9-Chaves.pdf>

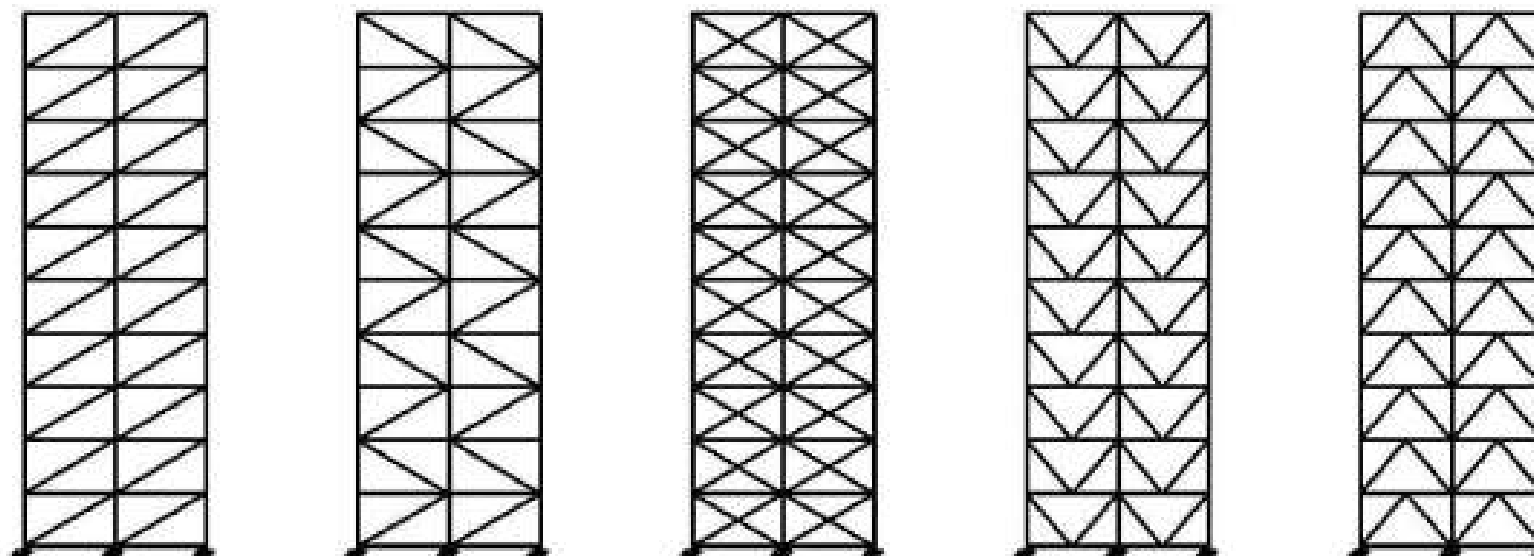


Figura 2.10 – Contraventamentos treliçados

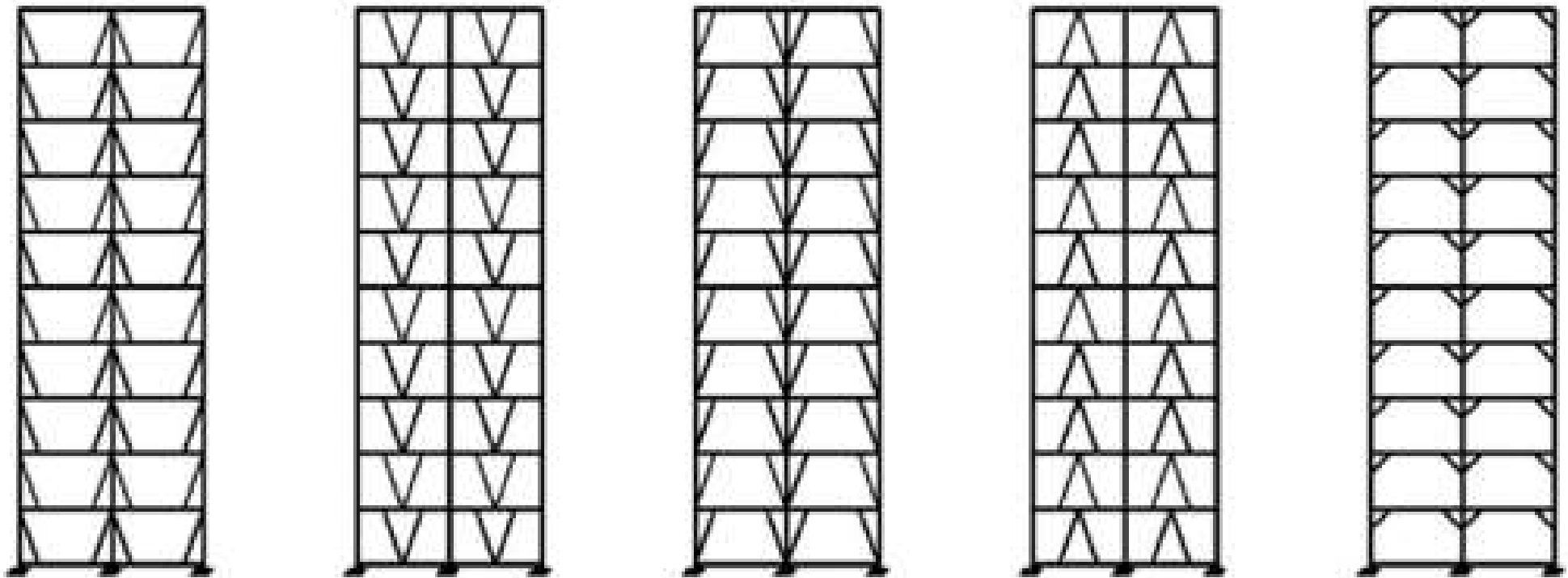
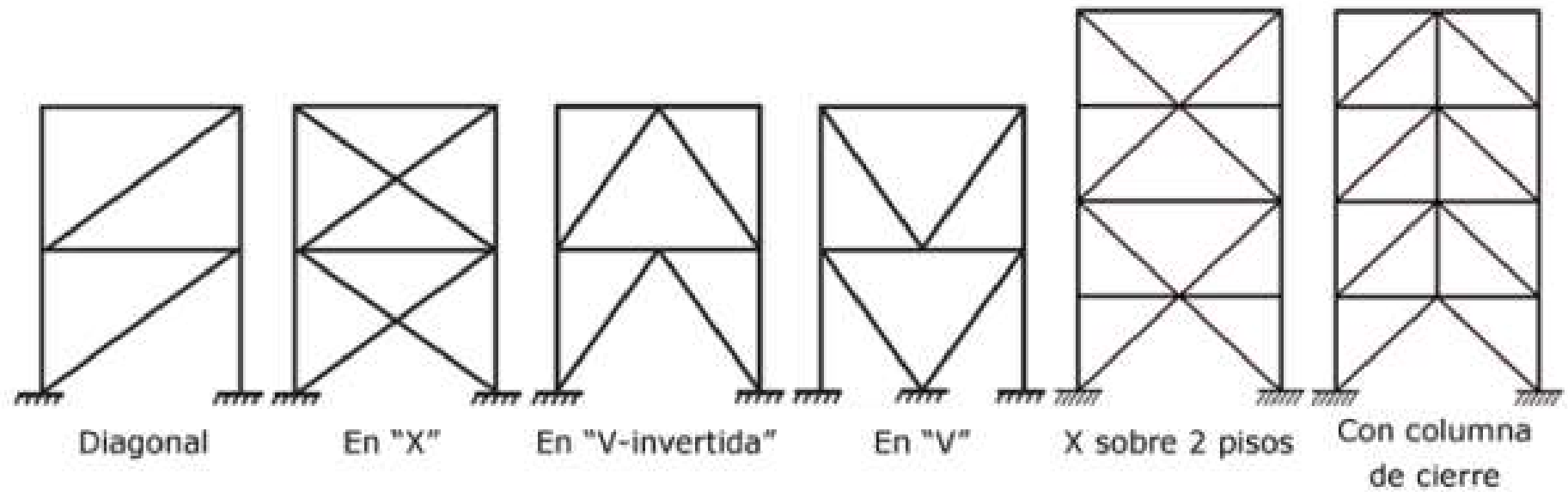
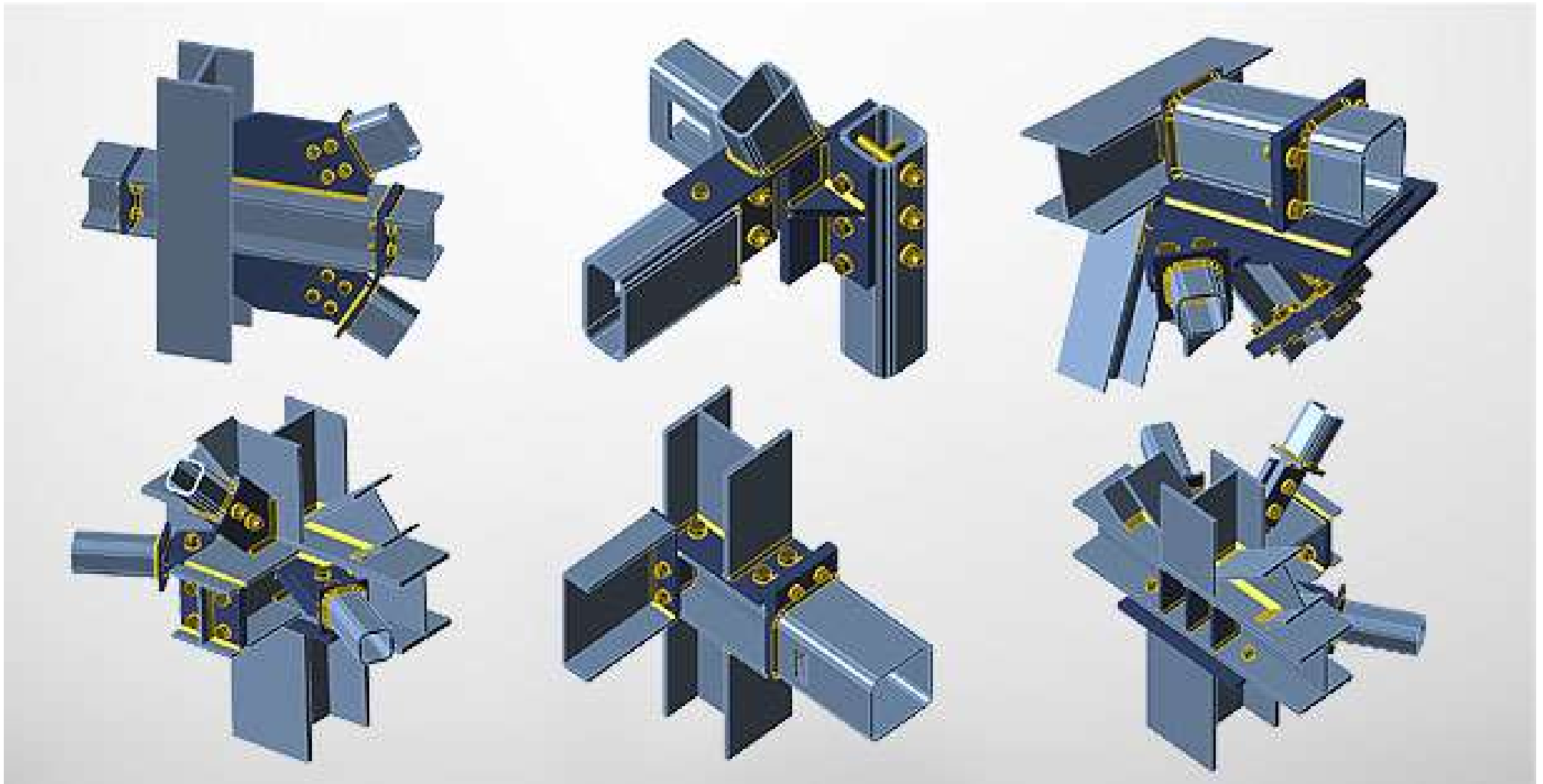


Figura 2.11 – Contraventamentos treliçados excêntricos



http://descargas.cype.pt/2018/versao_2018_a.htm





<https://www.gyourself.com/what-we-do/consulting-engineers/steel-connection-design-services-sussex-hampshire-london/>



<https://www.theengineeringcommunity.org/steel-bridges-connecting-methods/>



Tirantes estruturais

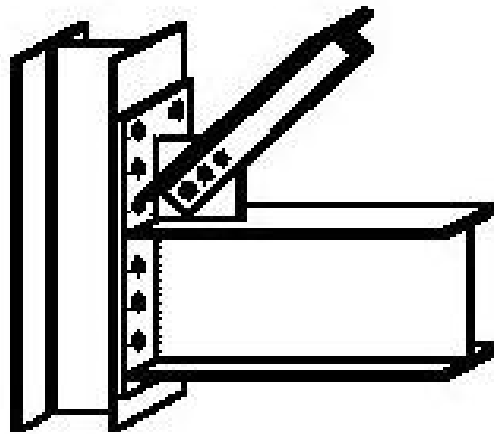
<http://www.high-strength-steel.com/structural-big-bolt-and-rod/structural-tie-rod>



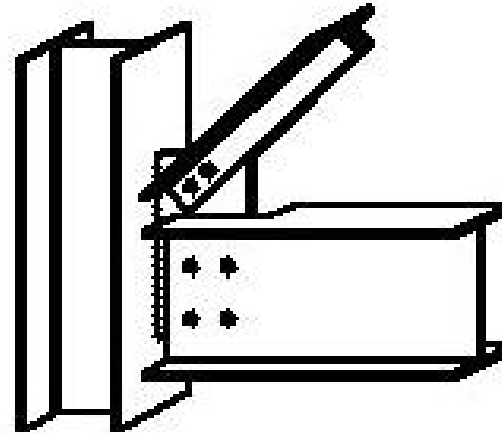




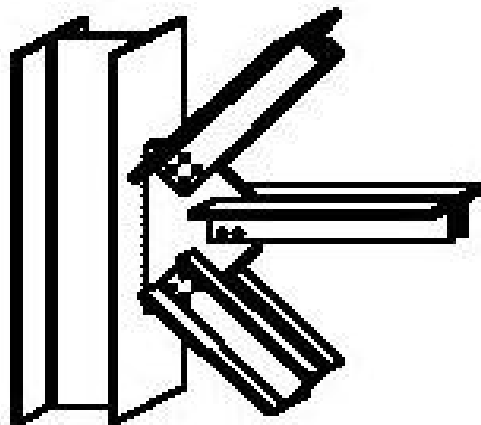
<http://www.high-strength-steel.com/structural-big-bolt-and-rod/structural-tie-rod>



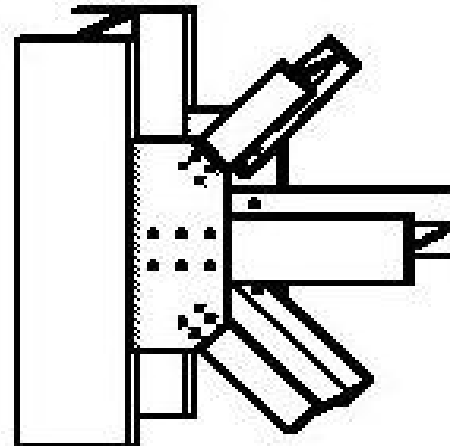
(1)



(2)



(3)



(4)

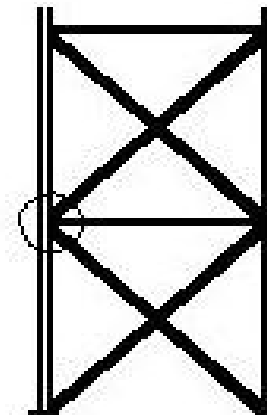
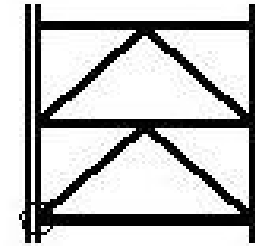
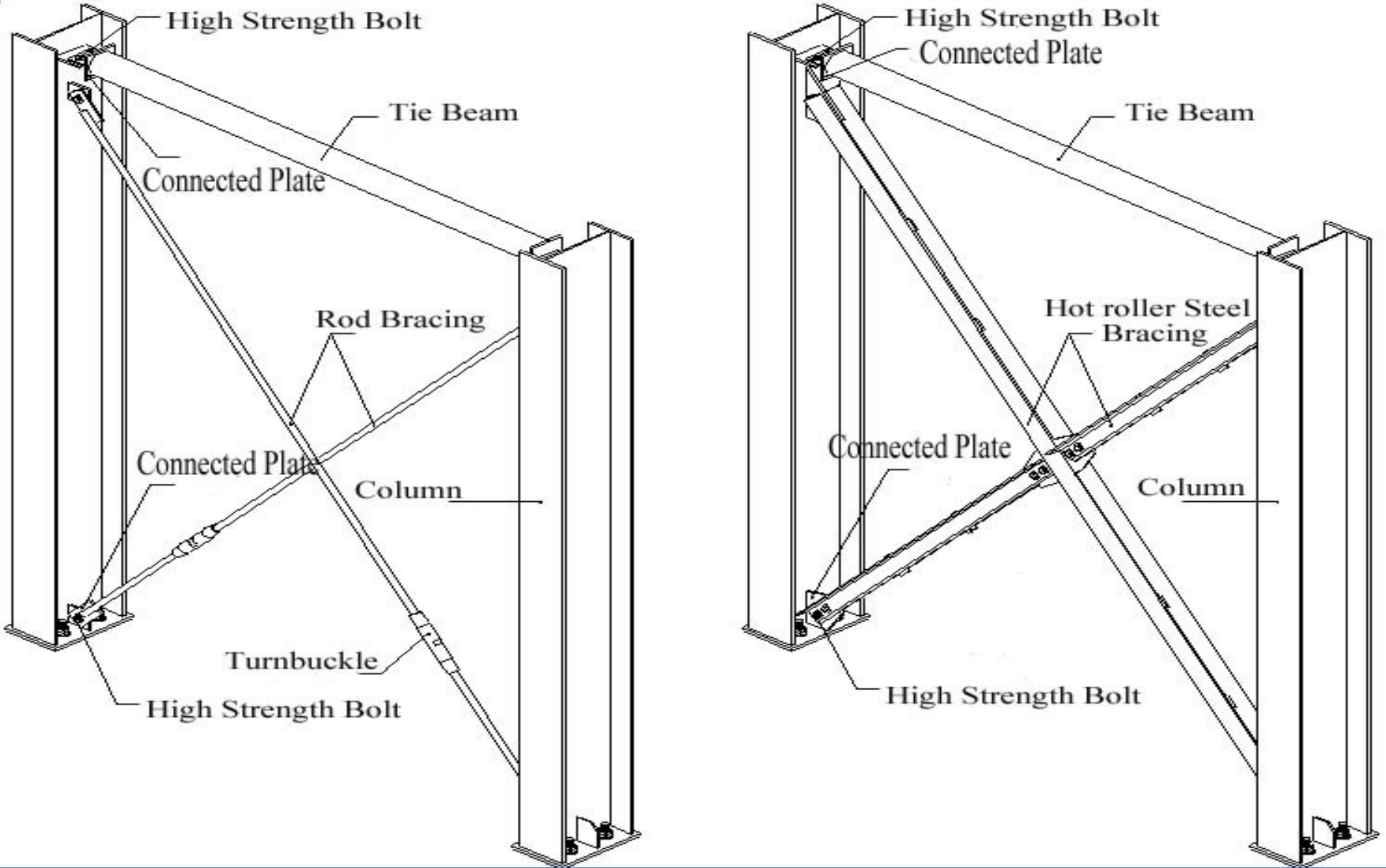


Figure 15 Vertical bracing connections

<https://havitsteelstructure.com/steel-structure-bracing-system/>





https://constructalia.arcelormittal.com/en/case_study_gallery/italy/innovative_steel_structure_for_the_mixed_use_building_area_22

publicações sobre aço na arquitetura.

<https://www.worldsteel.org/steel-by-topic/steel-markets/buildings-and-infrastructure/residential-housing.html>





<http://www.agsestruturas.com.br/galpoes-metalicos/estruturas-metalicas/estrutura-metalica-para-construcao-residencial/estrutura-metalica-para-edificios-consolacao>





<https://www.metalurgicazol.com.br/>



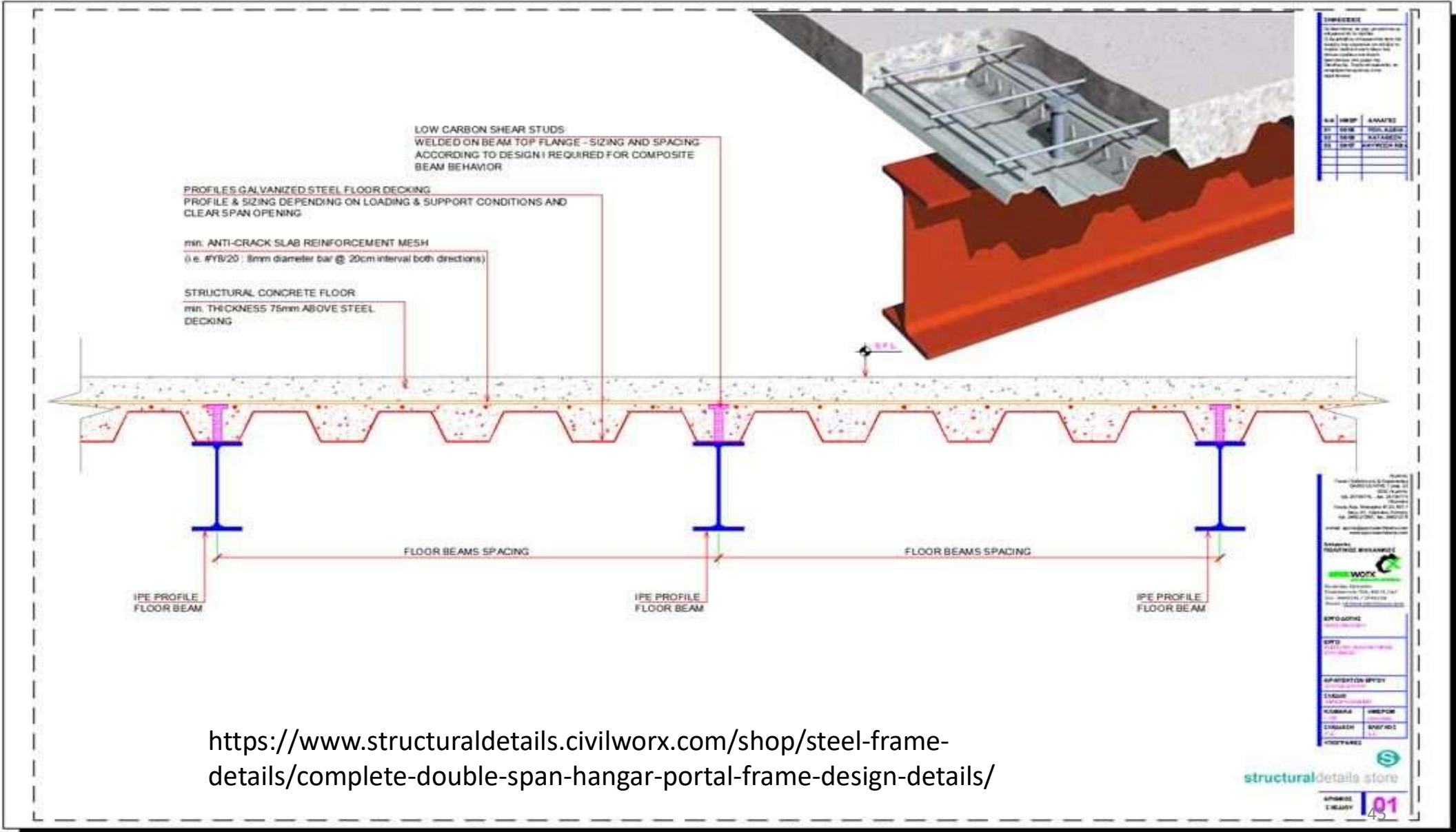
<https://metalicaesign.com.br/realizacoes/>

<http://www.pumalajesalveolares.com.br/estruturas-pre-fabricadas/estrutura-pre-fabricada-de-concreto/estruturas-pre-fabricadas-de-aco-preco-em-sao-paulo>



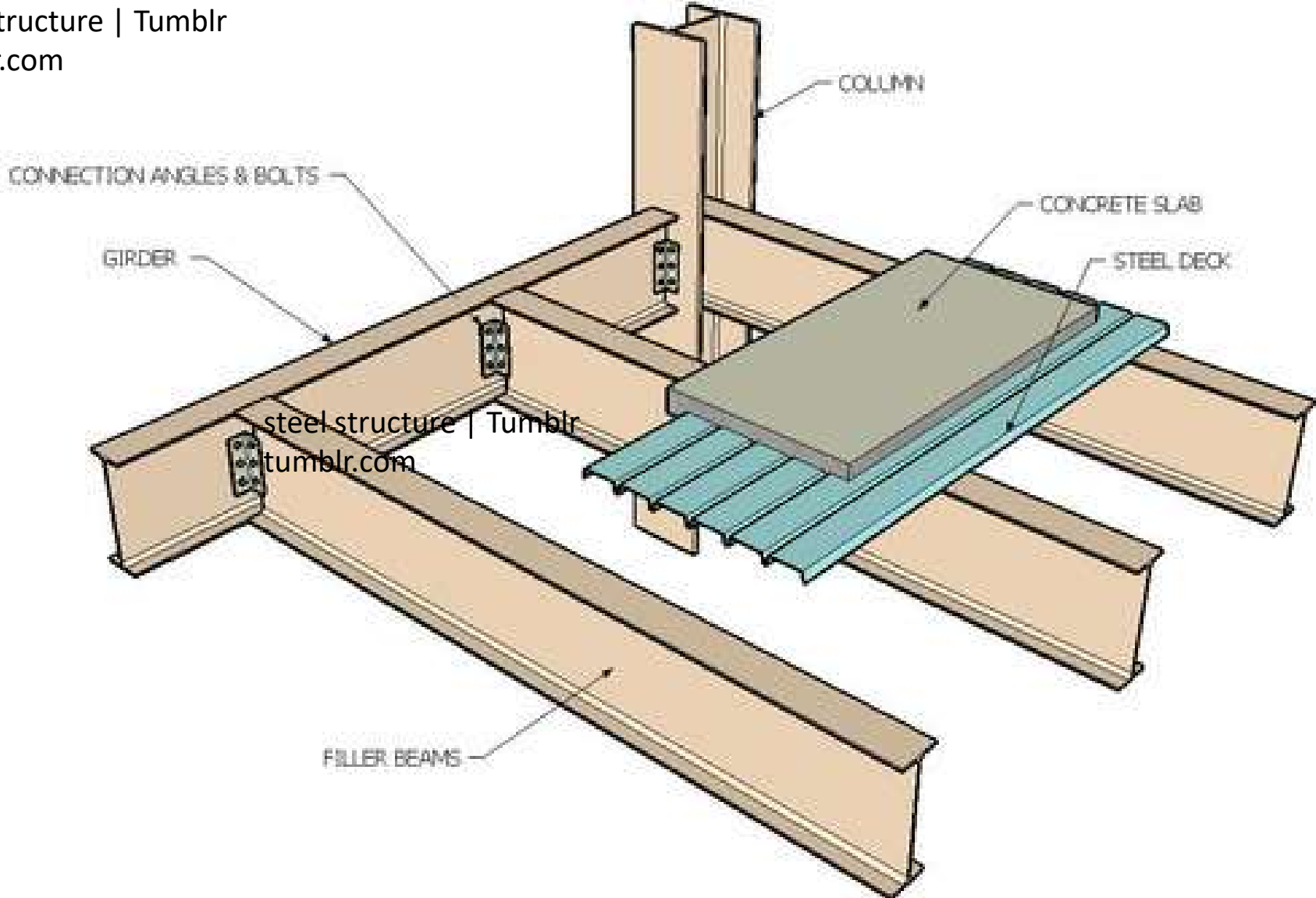


<http://www.pumalajesalveolares.com.br/estruturas-pre-fabricadas/estrutura-pre-fabricada-de-concreto/estruturas-pre-fabricadas-de-aco-preco-em-sao-paulo>



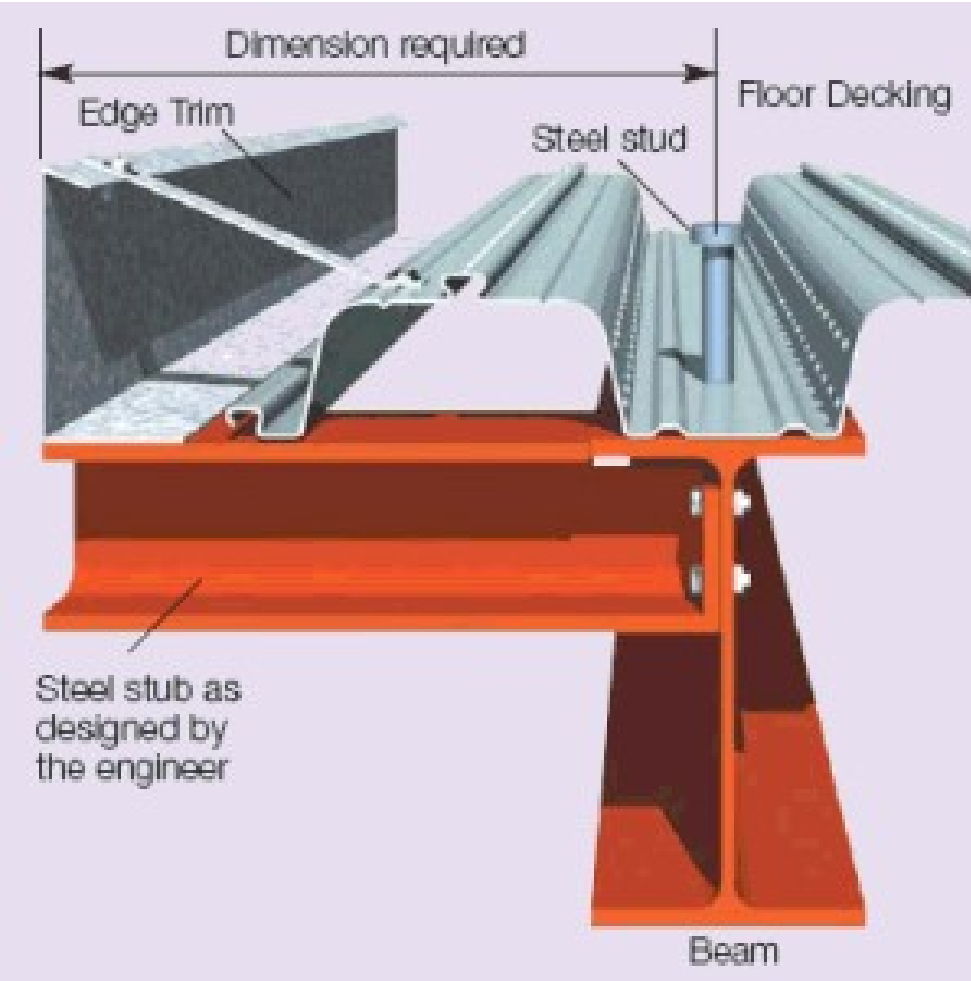
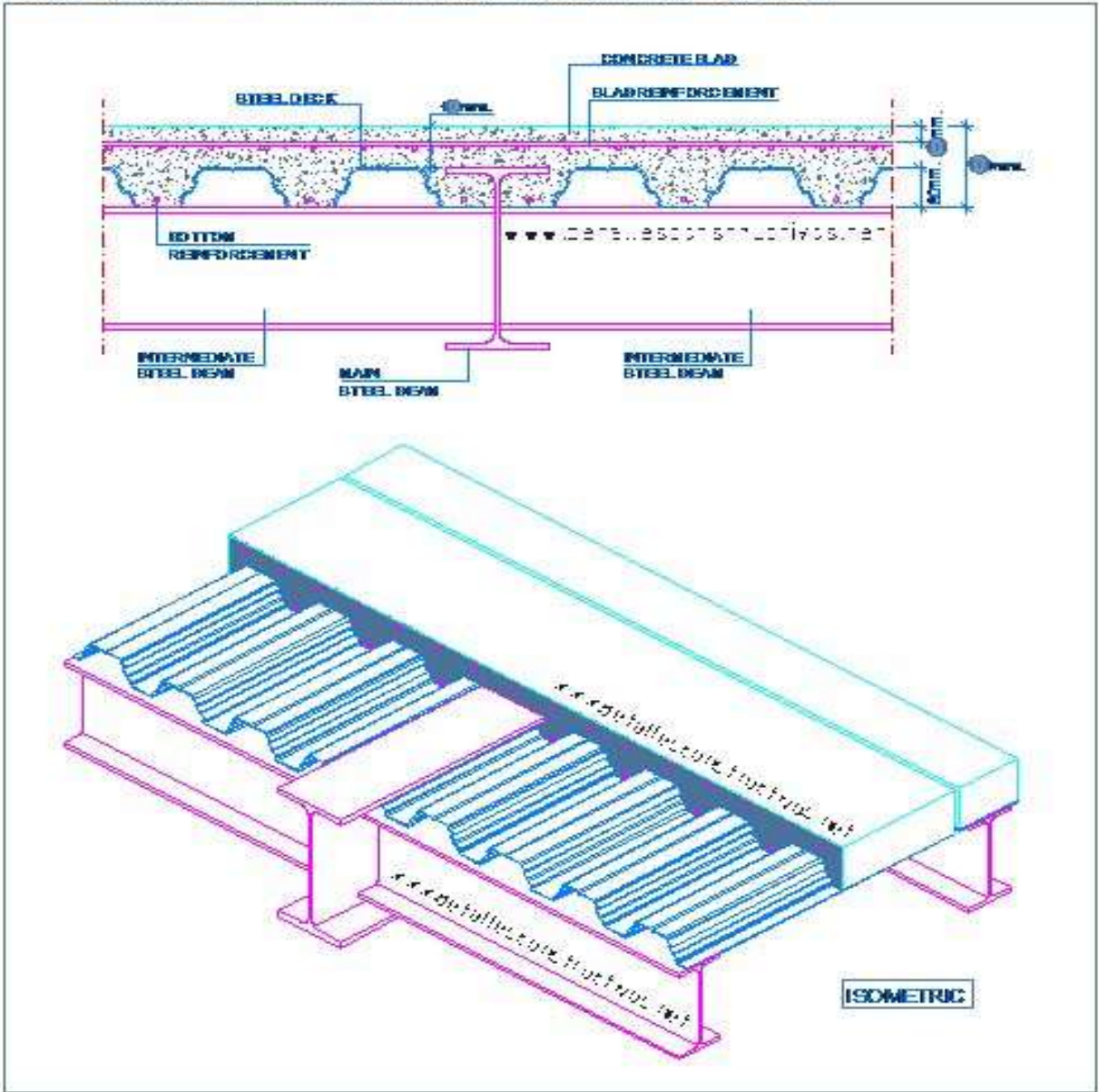
<https://www.structuraldetails.civilworx.com/shop/steel-frame-details/complete-double-span-hangar-portal-frame-design-details/>

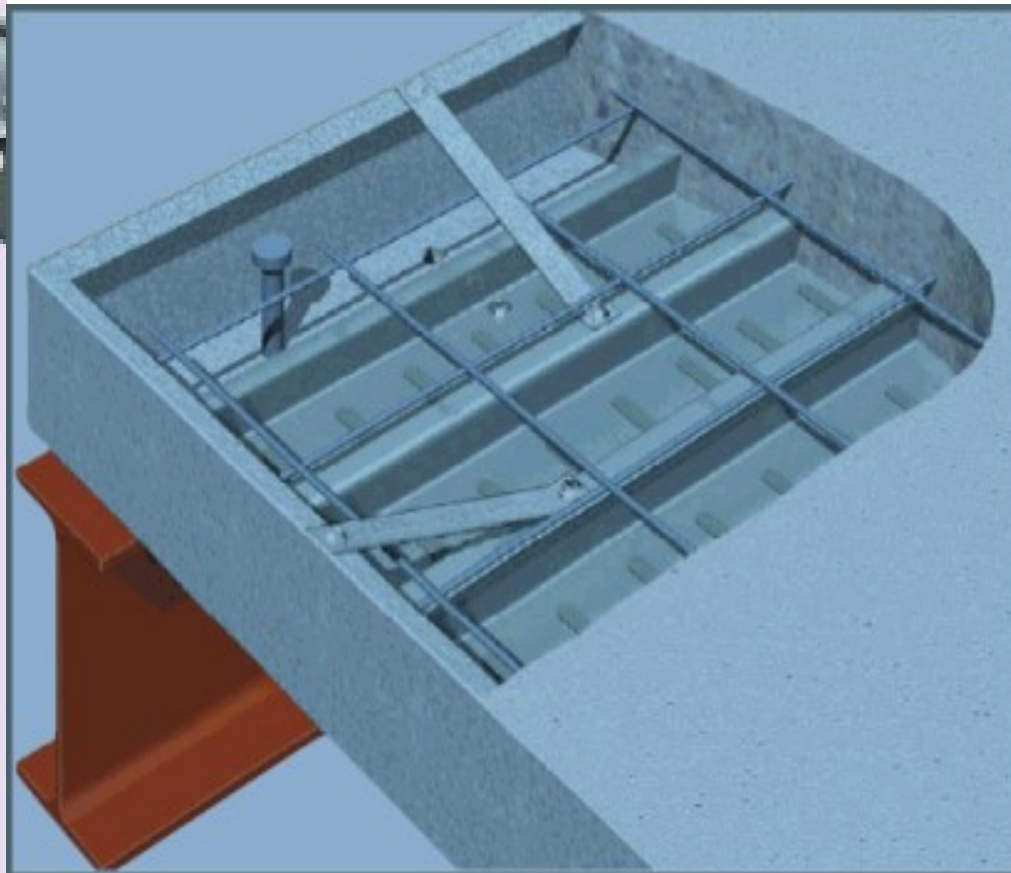
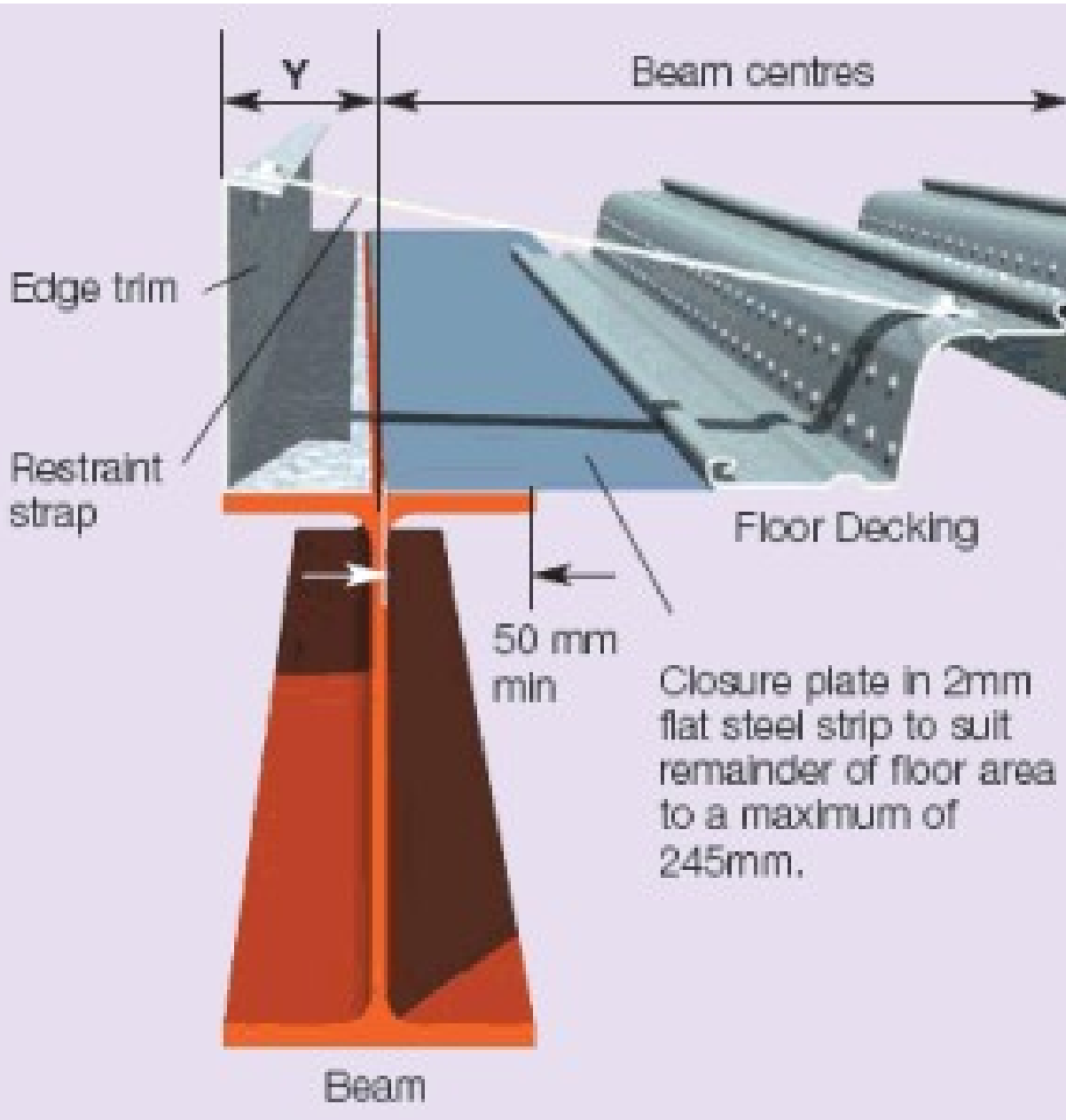
steel structure | Tumblr
tumblr.com



steel structure | Tumblr
tumblr.com

CONNECTION BETWEEN INTERMEDIATE AND MAIN DECK BEAM





http://www.supercivilcd.com/Composite/Learn/Deck_Specs.htm



<https://galpronto.com.br/servicos-laje-steel-deck.html>

<https://acomais.com.br/steel-deck-por-que-utilizar/>



<http://tekrollindustrial.com.br/portfolio-item/lages-steel-deck/>



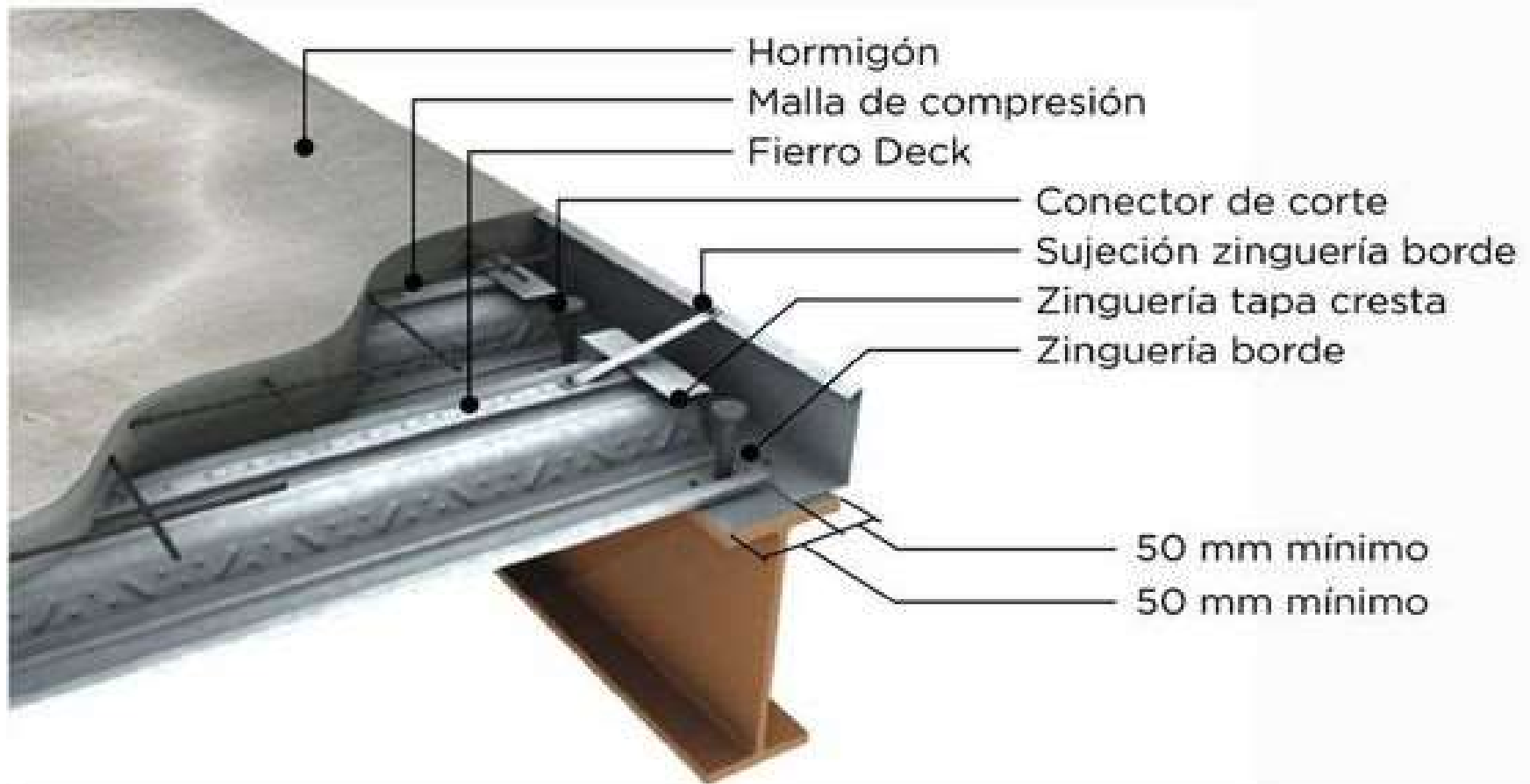
<http://tekrollindustrial.com.br/portfolio-item/lages-steel-deck/>



Detalle

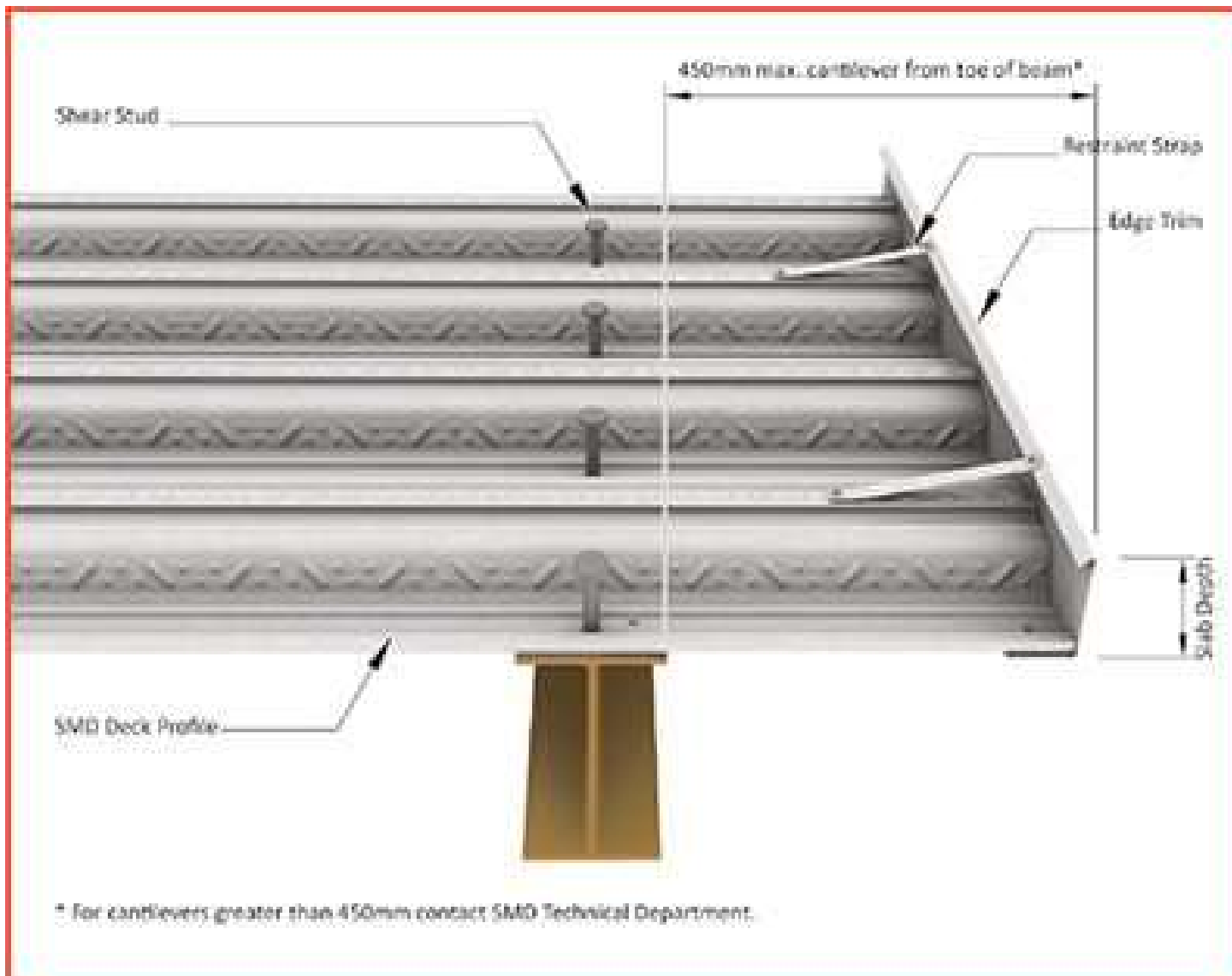
arq.clarin.com

► Las chapas preformadas de acero estructural galvanizado de diferentes espesores conforman junto al hormigón una losa estructural.



Fuente: Fierrodeck.com

CLARIN



Deck cantilever perpendicular to beams

Fig 4.7a





ESCADAS METÁLICAS

<http://www.acoplano.com.br/blog/conheca-o-processo-de-construcao-rapida-steel-deck/>





<https://renoguide.com.au/interior-design/50-amazing-and-modern-staircase-ideas-and-designs>





<https://renoguide.com.au/interior-design/50-amazing-and-modern-staircase-ideas-and-designs>



CASA MV - Projeto Casa 14 - arquitetas Mackenzistas Mariana Andersen e Mariana Guardani
<https://casa14.arq.br/?portfolio=casa-mv>

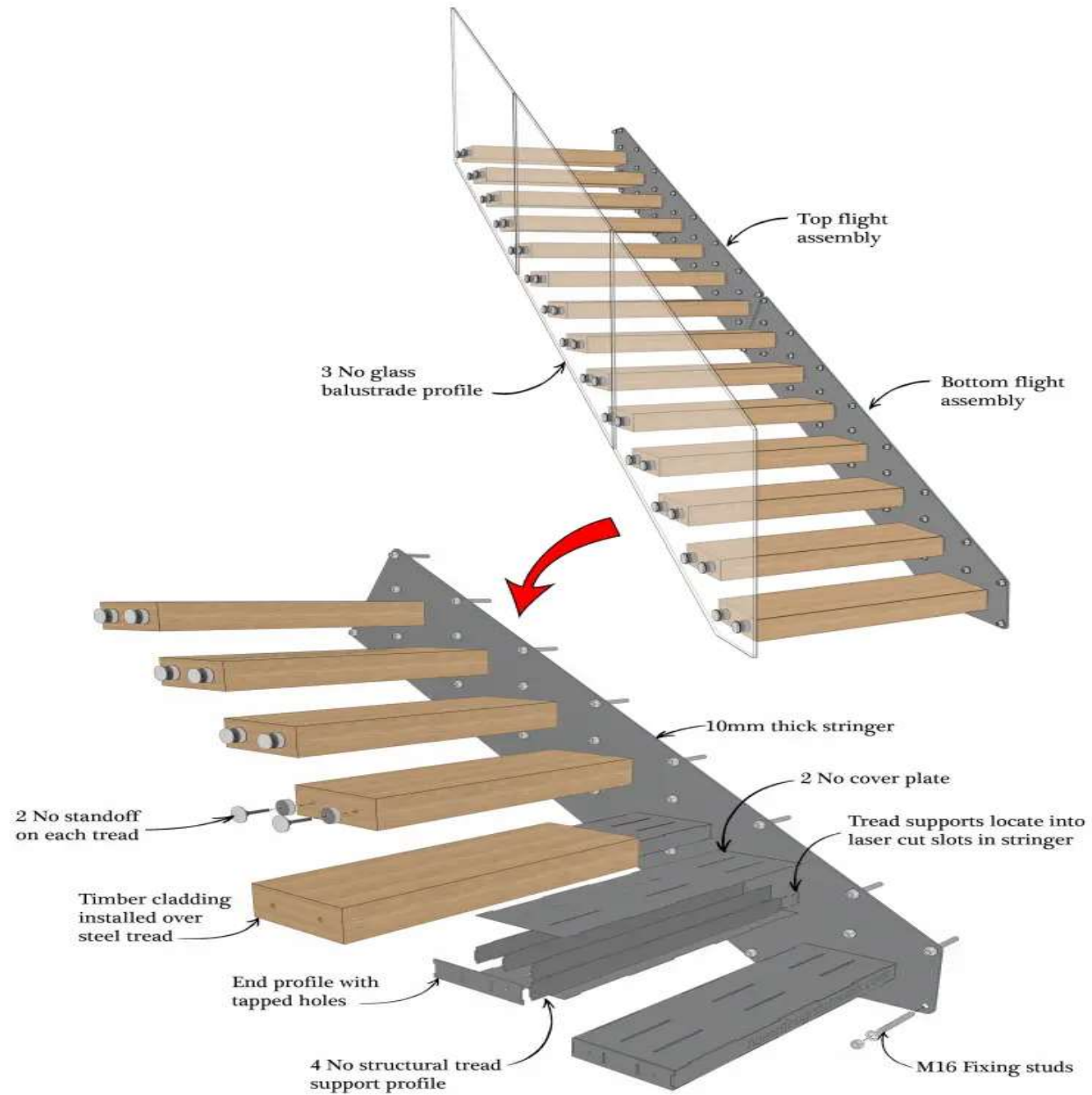


Larguras: 1,00m; 1,20m; 1,25m
Comprimentos: 1,00m; 2,00m; 3,00m
Espessuras: 3,00mm; 4,75mm; 6,35mm
Fornecedores: Aladim Metais, Galvaminas

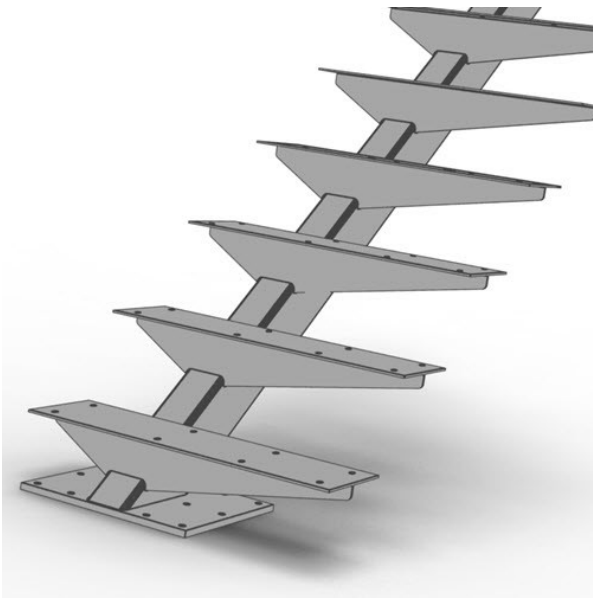
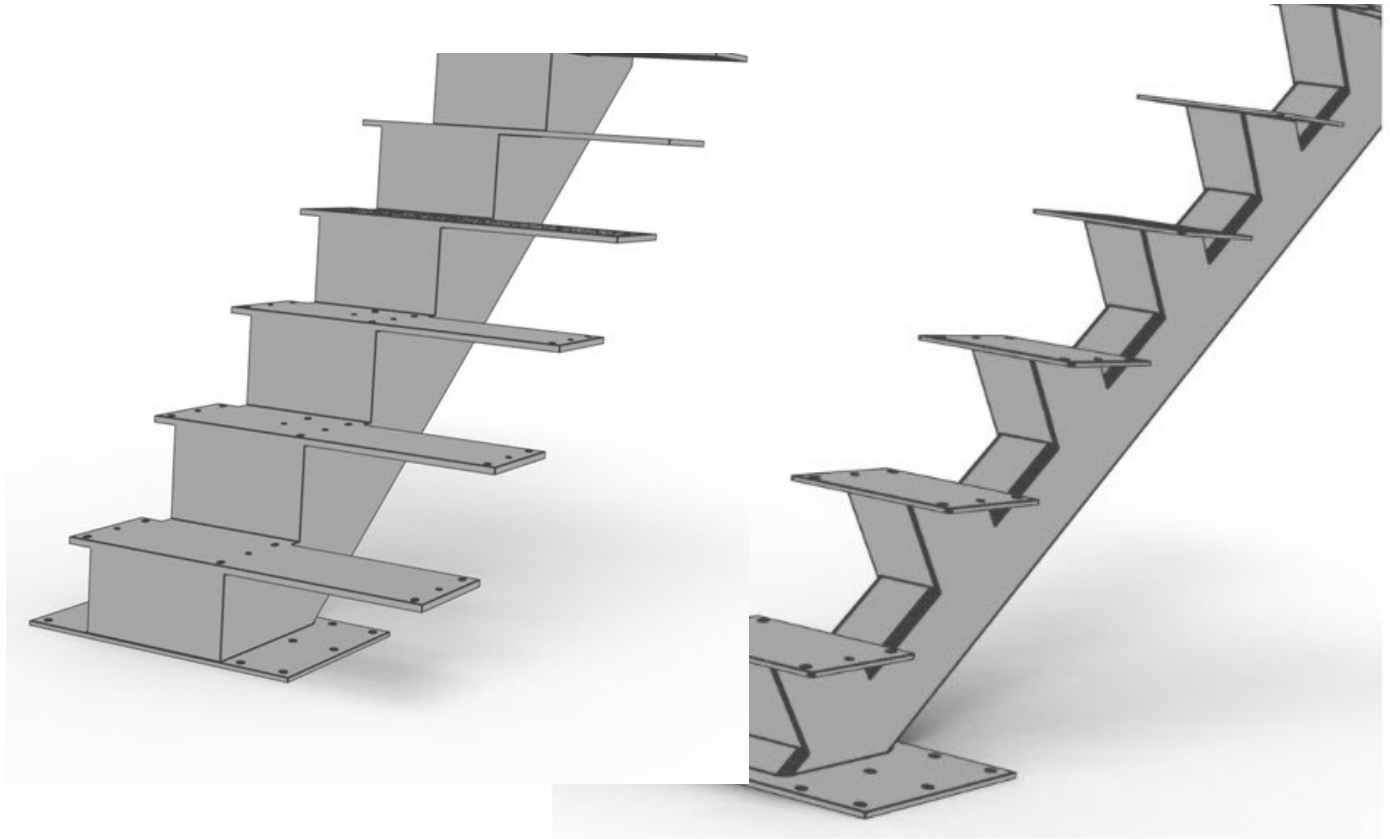
<https://www.aecweb.com.br/revista/materias/por-que-planejar-a-montagem-das-estruturas-metlicas-e-tao-importante/18255>



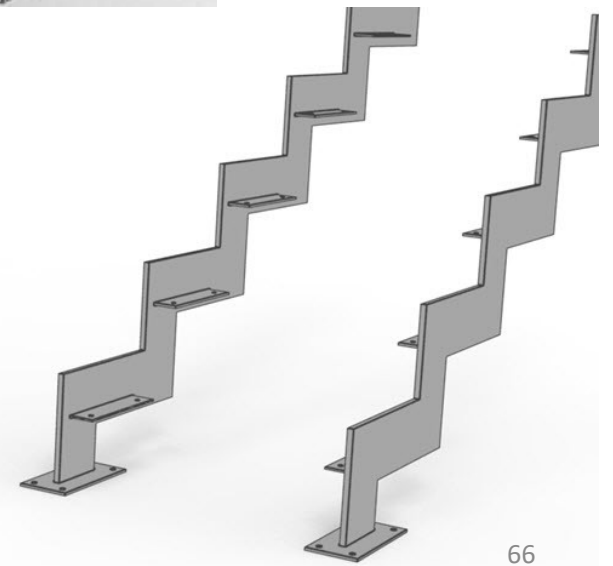
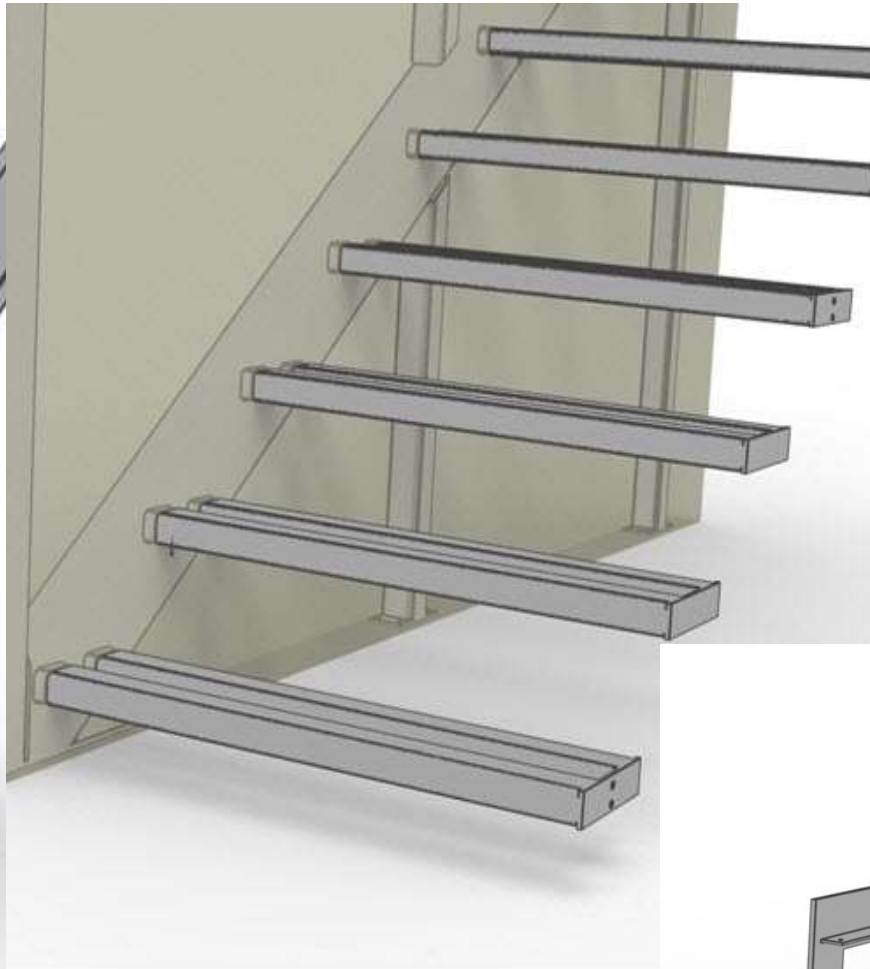
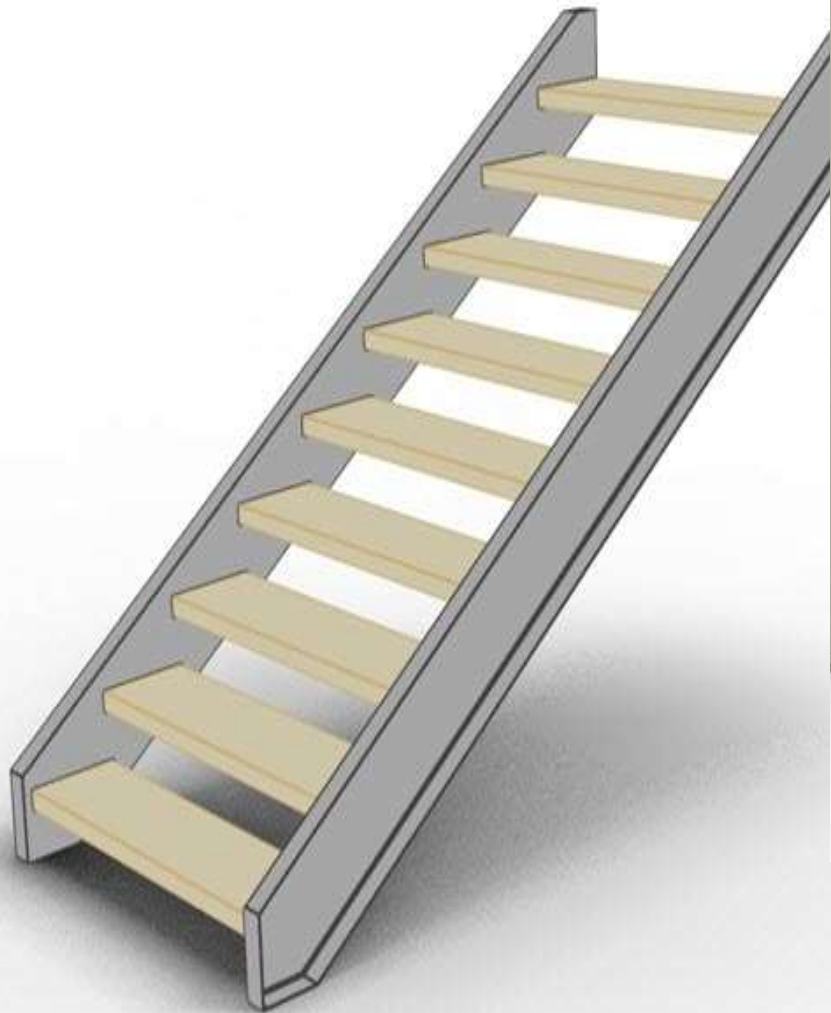
<https://homedesignutorials.com/2017/08/12/how-to-design-a-cantilevered-staircase/>







<https://www.keuka-studios.com/how-much-do-custom-floating-stairs-cost/>



<https://www.keuka-studios.com/how-much-do-custom-floating-stairs-cost/>

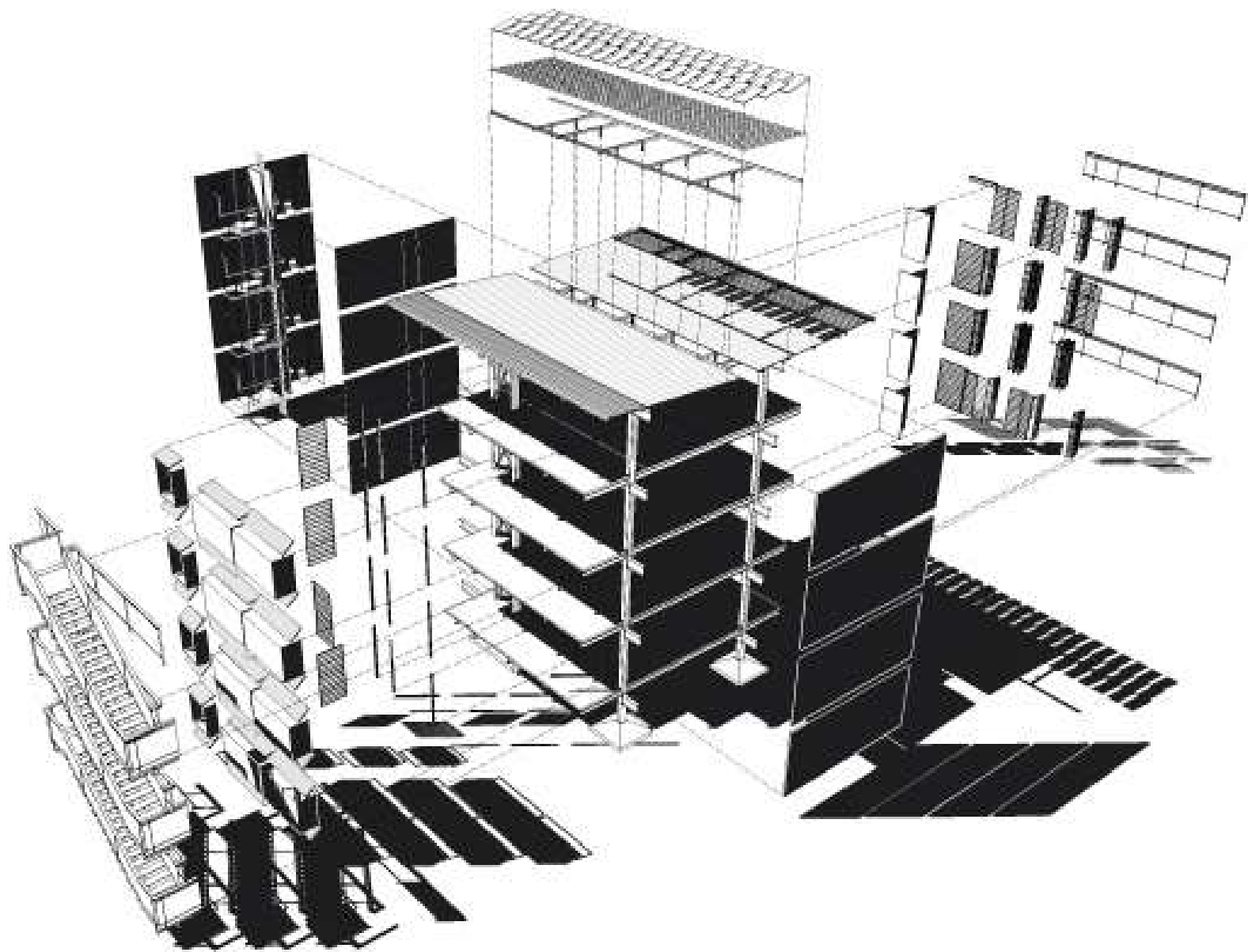


PASSARELAS METÁLICAS

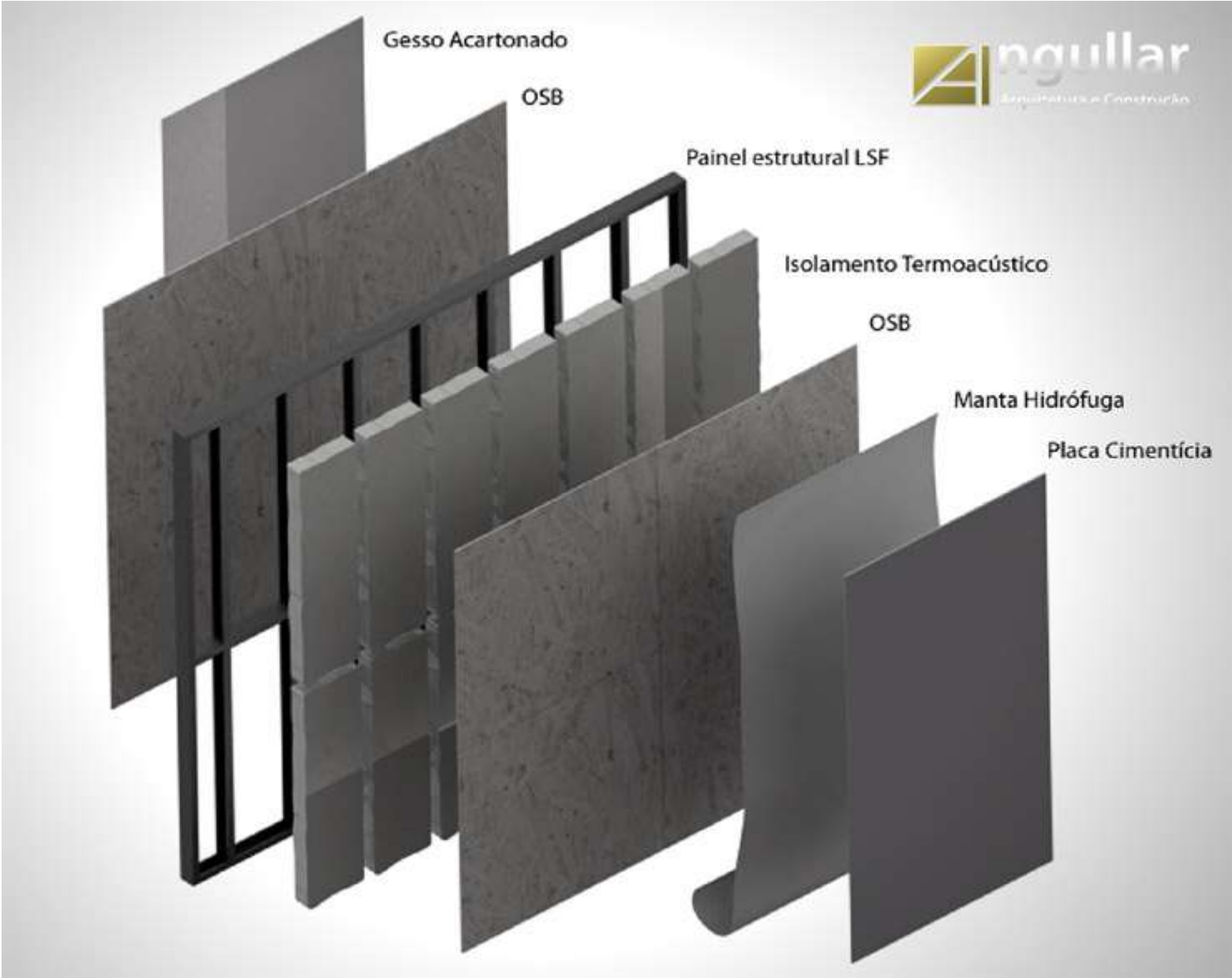
<https://scalatecnica.com/estrutura-metalica-para-passarelas/>

2º Concurso Internacional Living Steel
para Habitação Sustentável
Andrade Morettin Arquitetos
[https://www.andrademorettin.com.br/
projetos/living-steel/](https://www.andrademorettin.com.br/projetos/living-steel/)

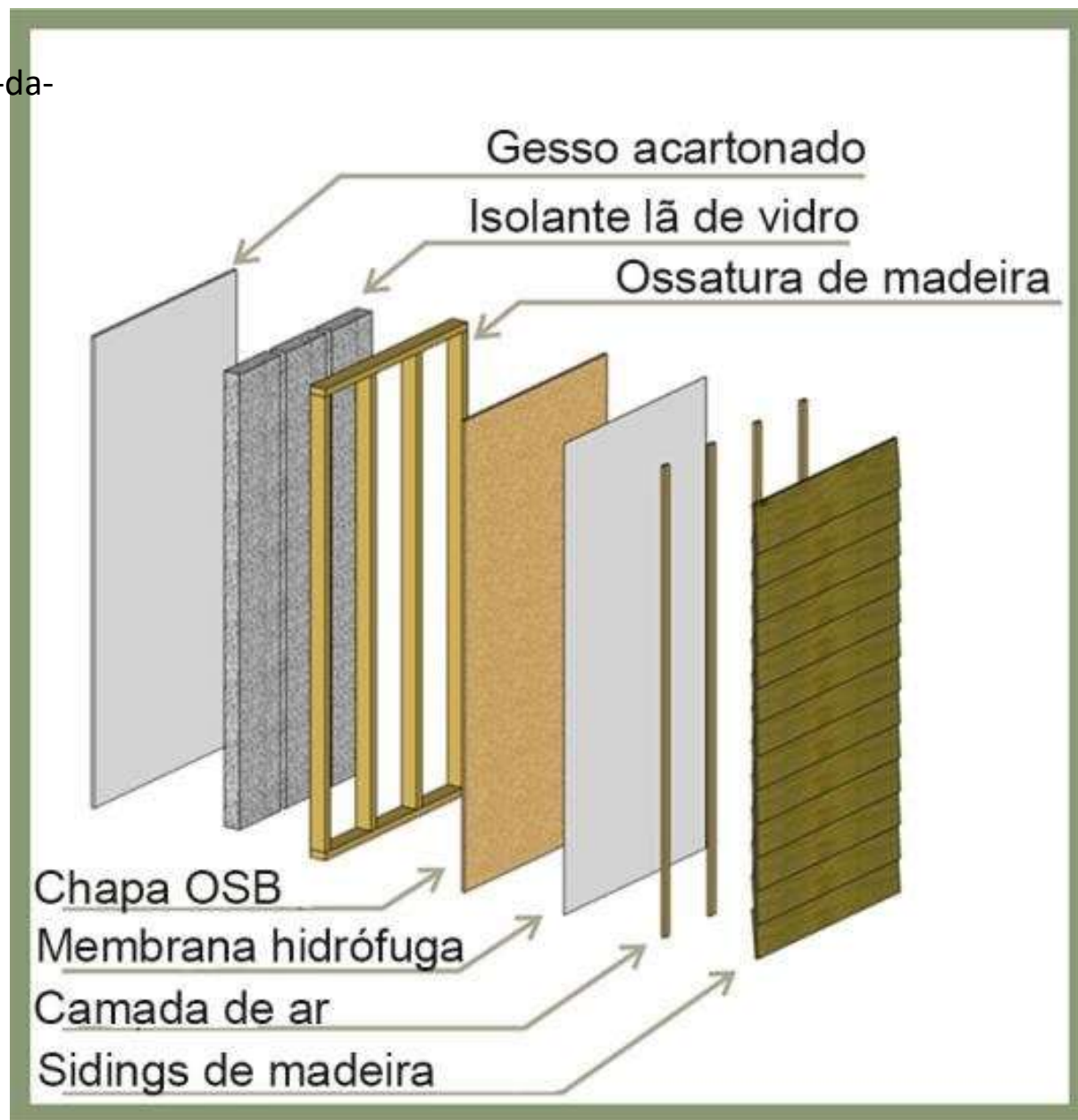




<https://www.angullar.com.br/steel-frame-e-sua-composicao>



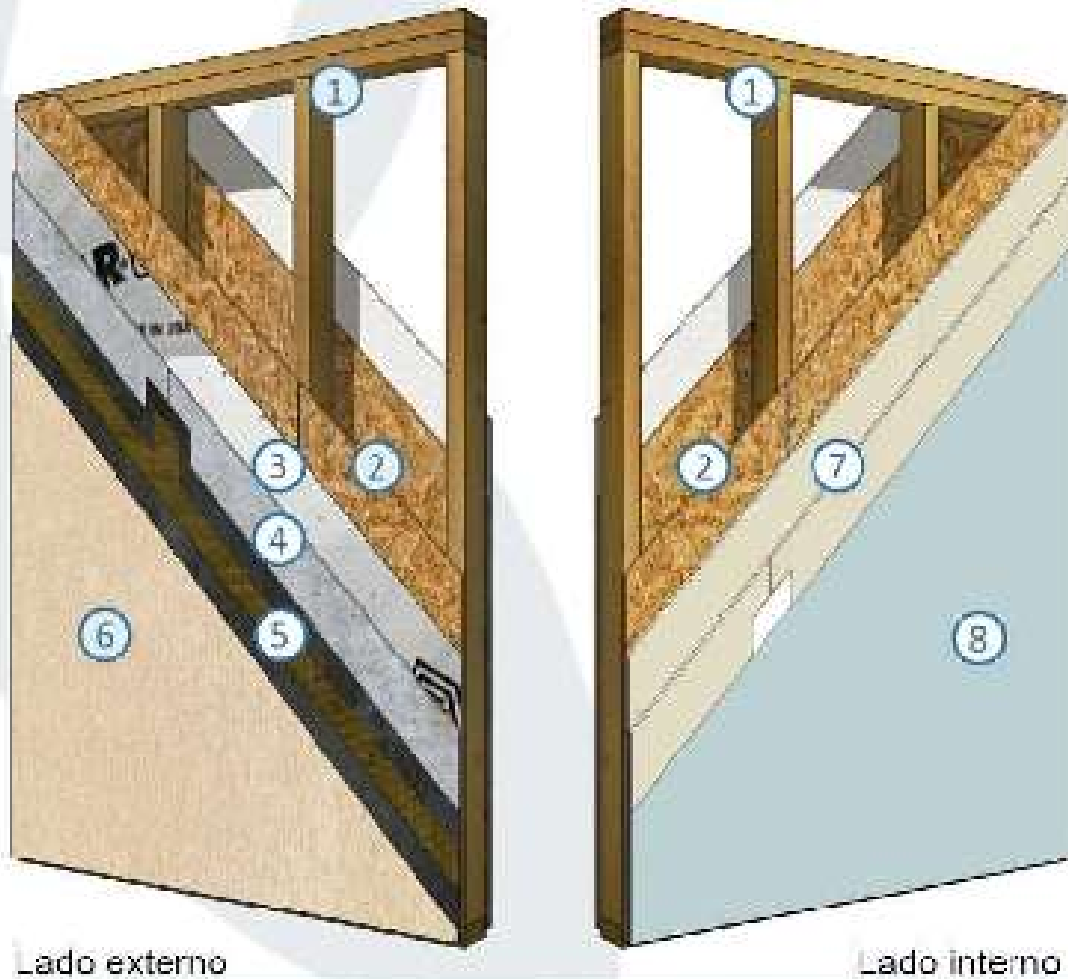
https://www.researchgate.net/figure/Figura-4-Camadas-da-parede-externa-proposta-para-analise-de-eficiencia-energetica_fig3_327569200



SISTEMA CONSTRUTIVO TECVERDE

Camadas da Parede

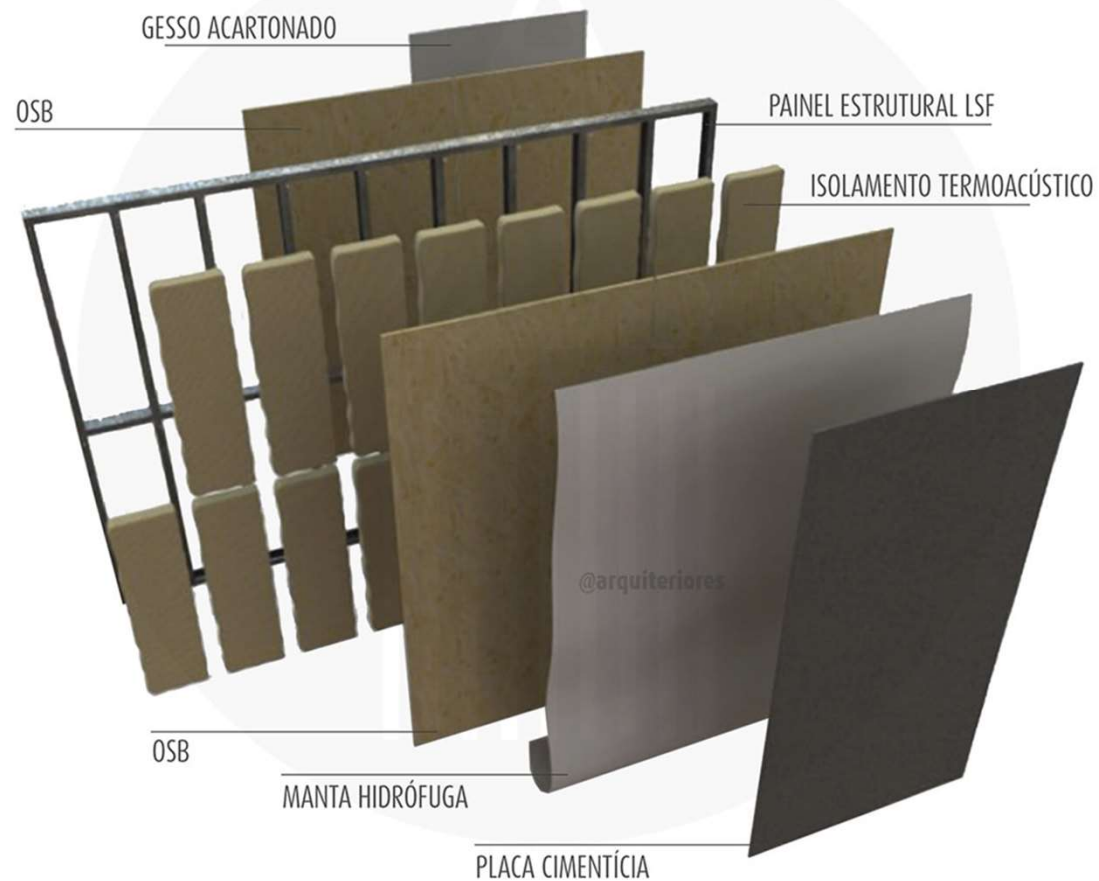
https://www.researchgate.net/figure/Figura-4-Sistema-construtivo-em-wood-frame-praticado-pela-Tecverde_fig3_329428249



1. Estrutura de madeira autoclavada
2. Chapa de madeira OSB
3. Membrana hidrófuga
4. Placa cimentícia
5. Basecoat com tela de fibra de vidro
6. Acabamento textura acrílica
7. Chapa de gesso acartonado
8. Acabamento pintura acrílica

<https://www.facebook.com/arquiteriores/photos/a.1597446373657800/3404894566246296/>

CAMADAS STEEL FRAME

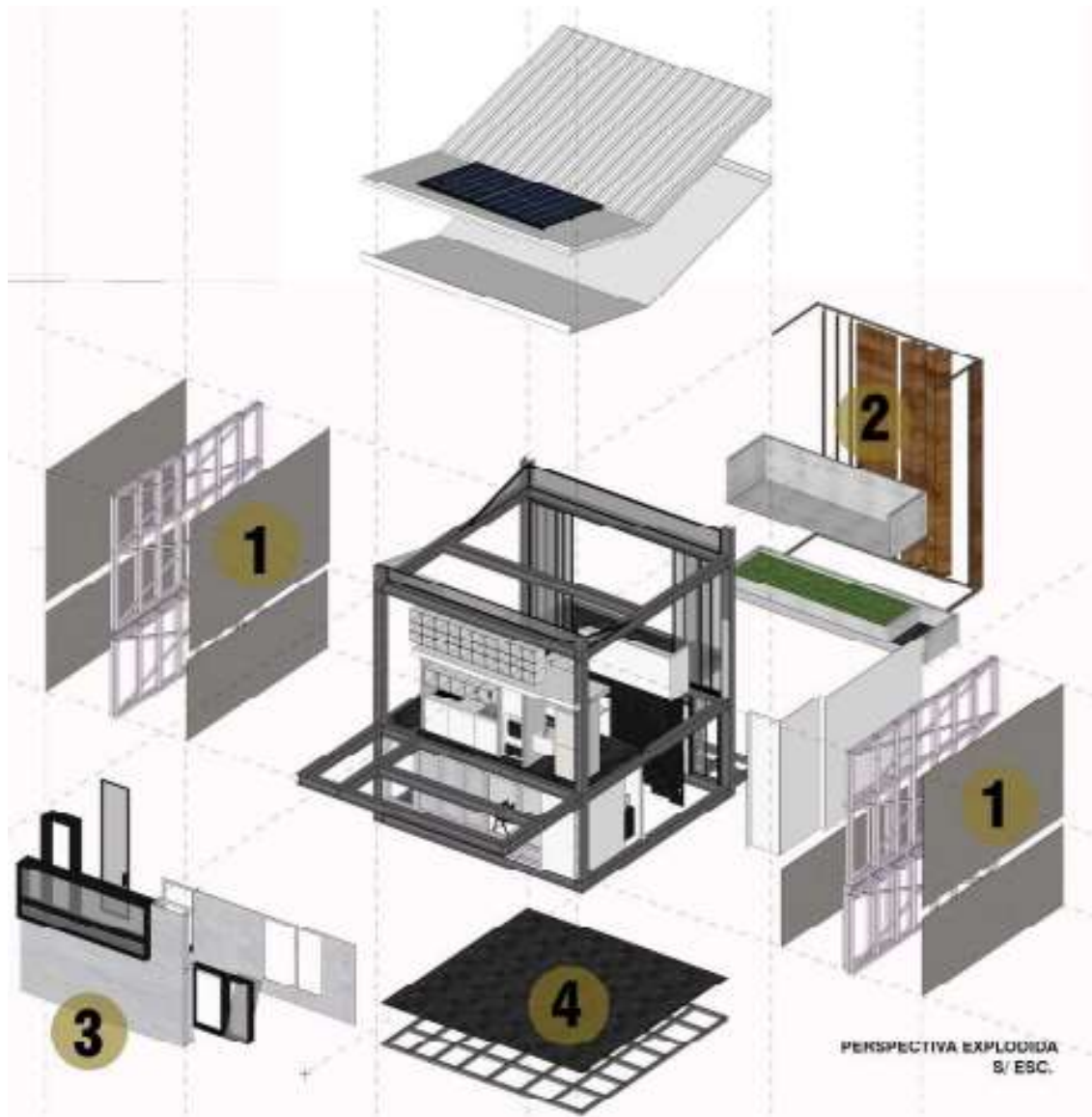


arquiteriores



/arquiteriores

arquiteriores.com.br



-1

EMPENA CEGA:

- _placa cimentícia
- _ossatura contraventada de alumínio
- _gesso acartonado hidrófogo (parede hidráulica)

-2

FACHADA 01 (VENTILADA):

- _estrutura metálica de metalon (10x5)
- _brise de madeira reciclada
- _caixilharia em estrutura de metalon revestida por chapa metálica

-3

FACHADA 02:

- _placa cimentícia
- _caixilharia em estrutura de metalon revestida por chapa metálica que oferece suporte a folha de caixilho de alumínio e vidro laminado (6mm)
- _porta de giro em caixilho de alumínio e vidro laminado (6mm)

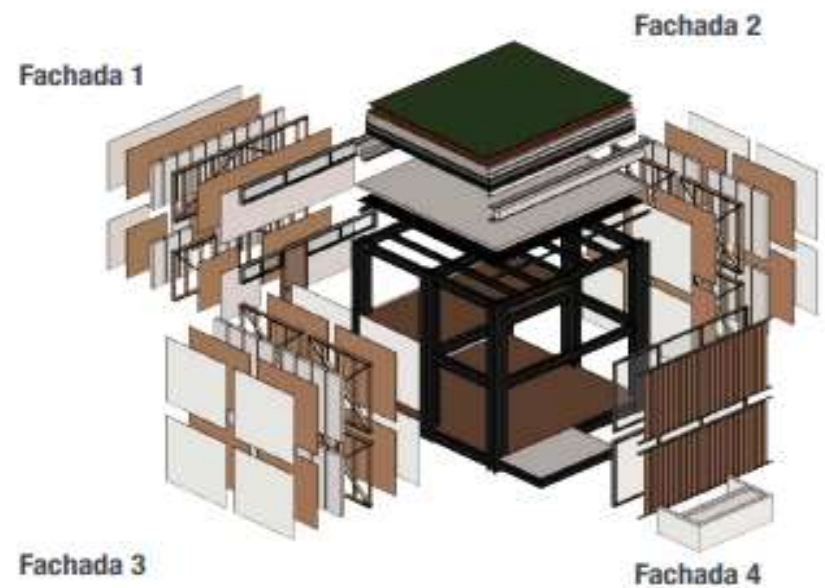
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PISO:

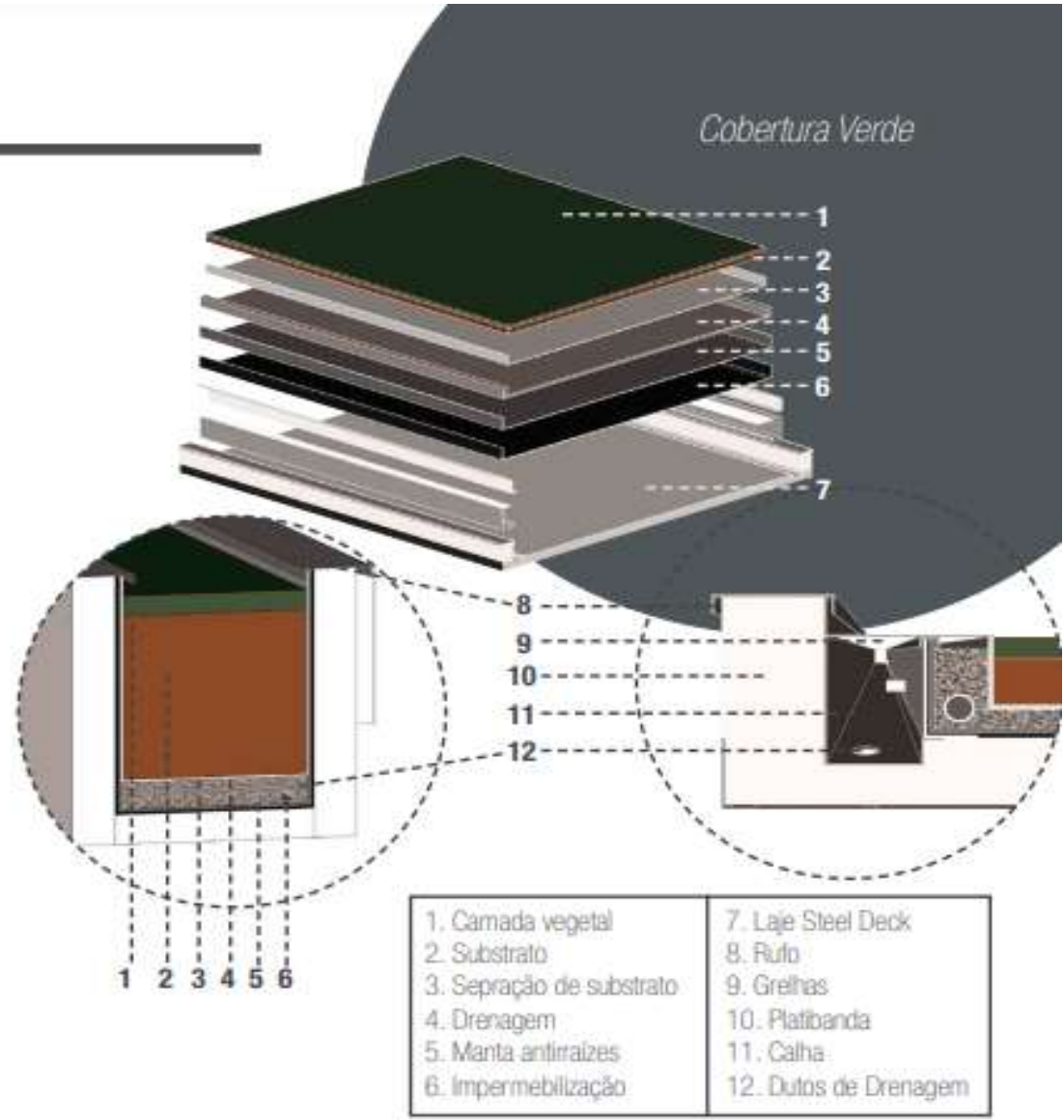
- _estrutura metálica de metalon (10x5)
- _revestimento em madeira laminada

FAU MACKENZIE
PROF. MARIA AUGUSTA JUSTI PISANI
MICAELA KOSMALKI MOIOLI MENDES 3191675-9

Casa Cubo - Perspectiva Explodida



Fachada 1	Fachada 2 e 3	Fachada 4
1. Janelas com caixilho e Porta	1. Gesso Acartonado	1. Janelas com caixilho
2. Gesso Acartonado	2. OSB	2. Brises Soleil
3. OSB	3. Montante Wood Frame contraventado	3. Jardineira
4. Montante Wood Frame	4. Lã de Rocha	
5. Lã de Rocha	5. OSB	
6. OSB	6. Gesso acartonado ou Placa ACM	
7. Placa ACM		



GRUPO DE PESQUISA



Detalhes de estruturas metálicas

Programa de Pós-graduação em Arquitetura e Urbanismo

Universidade Presbiteriana Mackenzie

novembro de 2021

MARIA AUGUSTA JUSTI PISANI