Construction of Steel structures

István Vidovszky PhD

historic overview

round 800 B.C. the general use of iron
16th-19th century wrought iron / cast iron (in Europe)
round 1870 A.D. the first production of modern steel
late 19th century multi-storey iron structure buildings
early 20th century the application of tower and mobile cranes in construction
**Material**

*Cast iron*: iron-carbon alloy with 2.1-3.6 wt% carbon content (used for cast building elements)

*Wrought iron*: in consequence of the fabricating process inhomogeneous iron-carbon alloy (likely to found in 19th century buildings)

*Modern steel*: homogenous iron-carbon alloy with 0.002-2 wt% carbon content

---

**Steel Structures**

*Main categories*

*Hall structures*  
*High (multi-storey) buildings*
Steel hall structures – static models

- structures with I/H-girders
- structures with truss-girders

Basic characteristics

- Prefabricated structural elements
- In situ assembled frame structures
- Welded or mounted joints
- Relative rapid construction process
### preparatory work phases

1. Design of the building
2. Preparation of element consignation
3. Planning the transport route
4. Planning the site arrangement
5. Selection of the temporary structures of the assembly
6. Planning the lifting sequence of the elements and the temporary bracing

### hierarchy of the structure

A. columns/pillars
B. girder
C. roof joists
D. wall studs
E. bracings
F. front frame
### element consignation

<table>
<thead>
<tr>
<th>ID</th>
<th>Figure (drawing)</th>
<th>Geometry (mm)</th>
<th>Weight (kg)</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>P-001a</td>
<td>4000x500x300</td>
<td>300</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>P-001b</td>
<td>5000x500x300</td>
<td>350</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>G-001</td>
<td>6000x500x300</td>
<td>420</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

### application of element consignation

What is the weight of the heaviest element?

What are the dimensions of the largest/longest element?

What is the total amount of the elements?

The largest weight to lift!

The largest object to transport!

The extent and the number of the transports!
### Work Sequence of the Assembly

1. Set up the site (layout)
2. Foundation
3. Installation of the temporary structures
4. Transportation
5. Lifting process
6. Preparation of the structural joints
7. Bracing
8. Corrosion protection
9. Disassemble temporary structures

### Organizational Questions

- Do structural elements have to be stored on the side? (Avoid if possible!)
- Is it possible to lift the elements directly from the trailer to their final place or a part of the structure have to be assembled on the ground before lifting?
- How can the shipments enter and leave the site? (Drive routes in case of a long-vehicle)
- What is to be considered as main equipment?
1. Transportation - site logistic

Organizational questions:

- How long trailer is required?
- What is the required load capacity of the trailer?
- What is the maximum vertical extension of the shipment?
- Is route permission required?
2. Site layout

Site set up (layout):

I. preparatory (row) set up – before the foundation is placed

II. fine set up – mark the exact place of the pillars on the foundation pads

3. Site layout, foundation

Usual foundation types:

A. prefab reinforced concrete pad foundation
B. prefab concrete pad foundation
C. monolithic concrete pad foundation
D. composite cases (e.g. monolithic concrete pad + prefab reinforced concrete elements)
4. Installing temporary structures

5. Lifting

tower crane:
accustomed application:
above 3 floors
5. lifting

mobile crane: optimal in case of relative low building height and huge vertical extension

1. lifting the elements
2. place the elements onto foundation
3. mounting at the joints with screws or wedges
4. setting temporary bracing
5. lifting

lifting (truss) girders

1. lifting the elements
2. placement of the elements onto their final place
3. mounting with screws or welding at the joints
4. assemble bracing

5. preparing structural joints

- welding
- mounting (with screw)

- temporary
- final
6. bracing + work sequence

- rod (for pressure and tension) or cable (for tension only)
- K, V or X shape
- in the predefined places

7. corrosion prevention

painting of the surface with a painting system:

primer + fire protection layer + cover painting
8. disassemble of temporary structures

remove scaffolding / temporary bracings

equipments

- cranes:
  - mobile crane
  - tower crane

- lifting tools:
  - spreader beams
  - wire rope slings

- rigging tools:
  - lifting tongue
  - eye bolt
  - shackles
  - clips
  - hooks
  - clamps
selection of mobile crane

relevant parameters:

1. Lifting heights =
   = the level of the final location of the element +
   the height of the highest element +
   + the height of the equipment (lifting and rigging tools) +
   + 1m

2. Lifting weight =
   = the weight of the heaviest element to lift
temporary structures:
- rolling scaffolding
- lifting platforms

hand tools: snips, hand seamer, hammer, screwdriver, measuring wrench, hand swagger, wire rope cutter

power tools: screw gun, cordless drill, electric shear, angle grinder
Airport, Stuttgart, Germany

Calgary, Canada
Beijing National Stadium, Peking, China

Oriente, Lisboone, Portugal
Divatcsarnok, Budapest, Hungary

Street decoration, Calgary, Canada
special examples

Thank you for your attention!
<table>
<thead>
<tr>
<th>References</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>[5] <a href="http://www.hoistquip.co.uk">http://www.hoistquip.co.uk</a> 2011.09.13</td>
<td></td>
</tr>
</tbody>
</table>