DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

DESIGN AND CONSTRUCTION OF STEEL CONNECTION

PREPARED BY:

MUHAMAD NAJMUDDIN BIN HASRI

2012621772

DEPARTMENT OF BUILDING

FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

SEPTEMBER 2014

It is recommended that the report of this practical training provided

By

Muhamad Najmuddin Bin Hasri

2012621772

entitled

Design & Construction of Steel Jointing (Welding)

accepted in partial fulfillment of requirement has for obtaining Diploma In Building

Report Supervisor	En. Mohd Najib B. Abd Rashid
Practical Training Coordinator	Puan Wan Nordiana Bt. Wan Ali
Faculty Coordinator	Dr. Mohd Rofdzi Abdullah

DEPARTMENT OF BUILDING

FACULTY ARCHITECTURAL PLANNING AND SURVEYING

UNIVERSITY TECHNOLOGY MARA

(PERAK)

SEPTEMBER 2014

STUDENT'S DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for which the original references stated herein. I've completed my practical training for 4 months started from 12 Mei 2014 until 29 September 2014 by the side of Preserver Bina Sdn. Bhd. This practical training report is also as a part of my duty to complete my practical training. Furthermore, it is also as one of my requirements towards this course DBN307 of Diploma in Building.

Name : Muhamad Najmuddin Bin Hasri

ID No. UiTM : 2012621772

Date : 29 SEPTEMBER 2014

ACKNOWLEDGEMENT

Alhamdulillah, thank you Allah S.W.T with His greaters allow me to completed my practical training in about 5 month with under Preserver Bina Sdn. Bhd.. Beside that, i would like to thanks to all individuals involved directly or indirectly in Preserver Bina Sdn. Bhd. whom help me to completing this practical training report especially my practical supervisor, En. Nur Rahmat Zainuddin as site engineer at site construction KL-Kepong Oleomas Sdn. Bhd., Pulau Indah, Klang. My acknowledge is also to my entire senior staff and supervisor in Preserver Bina Sdn Bhd because had thought me all about being supervisor in site and making decision to solve all problem produce in site. Thanks to Preserver Bina Sdn Bhd because allow me to be as their practical trainee from 12 May 2014 until 29 September 2014. Last but not least, to my report supervisor, En. Mohd Najib b. Abdul Rashid because support me at every single time, build my strength, give an idea in every single things to make this practical training report completely done.

Thank you very much

ABSTRACT

This report will review a general procedure on the erection of steel connection in construction and design. It is one of report that comes with complete guidance in every aspect of steel connection for specific project needs. Almost 5 months in practical training at Preserver Bina Sdn. Bhd. I have learnt so much about all steps, proper procedure and all requirements of steel jointing especially on site. Objective of this practical training report is to identify more precisely on how steel jointing are installed at site which is to study the method of steel jointing using the welding method (welding SMAW machine) and to identify welding method used for a few type of steel connection. Many methodology had been used to ensure this report completed, which is Primary Data and Secondary data. As a conclusion, A proper work of installation will definitely need a proper skill of labour and sufficient tools and machineries to do it. As we know all these tools will need to be sufficient enough to make a work become more easy and fast. This is because, not only the installation of work will requires the tools and machineries.

CONTENT PAGES

LIST OF TABLE

LIST OF DIAGRAM

LIST OF IMAGE

LIST OF SHORT-FORMS

SMAW	Sheild metal arc welding
QA/QC	Quality Approve/Quality Control

CHAPTER 1

INTRODUCTION

1.1 Introduction

For an introduction, steel structure are the most easier method used in any kind of construction industrial in entire world. If we see for example Eiffel tower at Paris, it's completely shown to us that the steel structure can make the building done faster, tougher and stronger, taller and make the symbol of engineering to the Paris. For another example, the Malaysian Penang Bridges structure is completely use steel structure. Penang bridges are the glory symbol for the Malaysia.

But in this report is directly shown only the steel jointing or steel erection using welding method. Installation method and the tools that related with this things.

What make this report different from others are, all the contents in this report are hereby provided by using a types of methodology which is an observation works, research or revision works and interview sessions from individuals involved. There are few type of methodology is done to help collect crucial information by practical method on proper step of installing steel jointing using welding method which is no other books or articles had written before.

Besides review on procedures of installation, this report will help to understand all the components function and tools needs for completing this installation work. All the problems relate to of steel jointing also will be generally review along with its recommendation on how to solve it.

1.2 Objective Reports

Objective of this practical training report is to identify more precisely on how steel jointing are installed at site. Other objectives are:

a. To study the method of steel jointing using the welding method (welding SMAW machine)
b. To identify welding method used for a few type of steel connection

1.3 Scope of Report

Scope of study for this report are practically review on methodology of installing an steel jointing. Besides getting more knowledge on components function and tools needed to complete the whole step of installation, it also will help to provide crucial information why steel is used as a beam that hold the load from above compared to other material used in construction field these days.

Therefore, this scope of study is done only under project named, KL-Kepong Oleomas Sdn. Bhd., which is to "Propose to Developed Additional Factory from 'Oleo Chemical' that included the SME Dry Plant, cooling room, SME Wet, Storage & Tower Room, Pipe Rack, Hydrogenation 7 storey and ME Distillation 6 Storey" is located at Section 5, Fasa 2D, Pulau Indah Industrial Park, Jalan Sungai Pinang 5/18, 42920 Pulau Indah, Selangor, Darul Ehsan. The actual owner of this land for KL-Kepong Oleomas Sdn. Bhd. project is KL-Kepong Oleomas Sdn. Bhd.

1.4 Methodology

1.4.1 Primary Data

Many methodology had been used to ensure this report completed, one of the method are reconnaissance. This project is developed a "Propose to Developed Additional Factory from 'Oleo Chemical' that included the SME Dry Plant, cooling room, SME Wet, Storage & Tower Room, Pipe Rack, Hydrogenation 7 storey and ME Distillation 6 Storey" for KL-Kepong Oleomas Sdn. Bhd.. This project is one of the biggest project for Preserver Bina Sdn Bhd. Therefore, method statement is needed to ensure all the details work are supervised properly. Pictures is taken for this report to showing the precise work of installation of steel using two method as mentioned. . This report interview session is need to be done to collect more information about installation of steel installation. This interview sessions is done with many individuals at Preserver Bina Sdn Bhd. Some of the interview individuals are site supervisor, engineer, and workers.

1.4.2 Secondary Data

Next is revision. All files, documents and drawing plan is needed as one of the methodology of this report. This documents and files is revised as revision to ensure that all the works are done according to its step. Most of the revision had been done from drawing plan, because that plan give completed view about design and specification of the steel jointing. Besides, some of the documents give more information about Preserver Bina Sdn Bhd profile and achievements. Therefore, revision is important to ensure this report is complete.

CHAPTER 2

COMPANY BACKGROUND

2.1 Introduction

Preserver Bina Sdn. Bhd. is one of the General contractors with a Steel fabrication factory. This company is specialize in construction including the Construction of factories and warehouse, Power generation, Petrochemical and Oleo Chemical Plants, Heavy Equipment Installation, Bridge and Infrastructural Steel Structures, Commercial Buildings and High-Rise Buildings, High-Ends show Units, Bungalows and Residential Building.

Preserver Bina Sdn. Bhd. had a multi-talented team of experts who works cohesively as a single force to provide technical expertise and consultancy. This company can design and tailor-make solutions according what clients needed. Besides have their own Steel Fabrication factory at No.22A, Jalan Tiara 5, Bandar Baru Klang, 41150, Klang, Selangor Darul Ehsan. Therefore, this company will match every factory specifications, locally and overseas.

In 17 April 2009, Preserver Bina Sdn. Bhd. had cooperated with its own partner business as known as Alubina Sdn. Bhd. to listed services included fabricated and installed an Aluminum components for General construction and Infrastructural projects as well as Residential divisions. Alubina Sdn. Bhd. services are backed by very experienced technicians and professional knowledge to ensure high quality products to fulfill client's needs.

2.2 Company Profile

Company Name	:	PRESERVER BINA SDN. BHD. (610805-M)
Partner Name	:	ALUBINA SDN. BHD.
ROC Registration No	:	853439-K
Incorporated on	:	17 April 2009
Paid-Up Capital	:	RM 100,000.00
Authorized Capital	:	RM 100,000.00
Address (Office)	:	Lot 8292, No.2, Tingkat 1, Jalan Istimewa, Kg. Batu Belah, 41050, Klang, Selangor Darul Ehsan
(Factory)	:	Lot 4977 & 4978, Jalan Dahlia, Off Jalan Meru, 41050 Klang, Selangor Darul Ehsan.
Directors	:	Khoo Beng Aun, Wong Kok Meng, Soon Kian Eng, Khoo Beng Seong
Bankers	:	United Overseas Bank (UOB)
Tel. No.	:	
Fax No.	:	+603-33447013
Email Address	:	pbinasb@gmail.com

2.2.1 Information Establishment

Preserver Bina Sdn. Bhd. was incorporated in April 2003. This company is also known as a general contractor with a steel fabrication factory. Preserver Sdn. Bhd. had a long list of services. This company has registered as a Grade 7 Contractor with the Construction Industry Development Board (CIDB). After a decade, this company has secured the prestigious ISO 900 1:2009 Award.

Preserver Bina Sdn. Bhd. has successfully completed significant projects in general construction, Infrastructural projects and Steel Fabrication. . Therefore, this company had won an awards and recognition by clients and the industry's authorities by tailor-making better solution, locally and overseas. For residential division's Preserver Bina Sdn. Bhd. specialize in bungalows, transforming homes, townships and gated communities. This includes designing and constructing the residential building. Preserver Bina Sdn. Bhd. have their own steel fabrication factory, with the latest machinery to maintain the high quality standards and to ensure the steel products is the in a best condition. With these standards Preserver Bina Sdn. Bhd. leaves their factory matches international specifications.

Besides that Alubina Sdn. Bhd. is also a business partner with Preserver Bina Sdn Bhd. Alubina Sdn. Bhd. is a leading contractor for Aluminum & Glazing works includes Aluminum Composite Panels, Glass Canopy, Curtain Wall, Skylight Glass Canopy, Box Louvers, Sun Louvers, Aluminum Windows, and Aluminum Doors. This partnership is incorporated almost 6 years with Preserver Bina Sdn Bhd. this partnership also had established itself as a reputable and reliable business partner in all related projects

Preserver Bina Sdn. Bhd. assures that the best performance to deliver results as promised and works towards win-win deals. This company ensures every output in a high quality standards, overall quality control, cost effectiveness, and efficiency will

speed up projects and meet the deadlines as promised. Preserver Bina Sdn Bhd aims to get better in future and stay ahead in the industry, so that they can remain the preferred choice in General Construction, Infrastructure projects and Steel

2.2.2 Company Awards

The Awards and accolades Preserver Bina Sdn. Bhd. has won over the years prove their capabilities. Among the significant ones are:

- 2 Awards from the Malaysia Architects Association (MAA) – Excellence in Architecture – Winning Showroom Building PAM 2007 for the Ameera Residences Sales Gallery.
- Honorary Mention Showroom Building PAM 2007 Awards for excellence in Architecture for the ONE Menerung Showroom & BRDS Sales Gallery Project.
- Achieved 3,000,000 and 2,000,000 Man Hours Without A Lost Time Incident in its Coal Fired Power Plant from TAISEI CORPORATION (in 30th September 2007 and 21st February 2008 respectively).
- Special Recognition as a Specialist Sub-contractor for the SUNCON GROUP OF COMPANIES' Overseas Projects (Sunway Construction).
- Achieved 2,500,000 Man Hours Without Lost Time Accident Safety Performance For the Superstructure Works – 3A University Technology Petronas, Tronoh, Perak. Recognition by NAMFATT-ZAQ JV (31st March 2004)
- ISO 900 1:2008, CONSTRUCTION OF STEEL STRUCTURE.
- Preserver Bina also won numerous Recognition for Architectural excellence, outstanding reliability and superior performance from numerous other leading developers.

2.3 Company Objectives

Preserver Bina Sdn. Bhd. aims to get better and stay ahead from other companies in the industries, so that they can remain as the preferred choice in General Construction, Infrastructural projects and Steel Fabrication.

2.3.1 Mission

Preserver Bina Sdn. Bhd. dedication is to constantly improve in all aspects of operations more than just a daily lived philosophy. It's what keeps Preserver Bina Sdn. Bhd. ahead. This company goes the extra mile, design and delivers what clients expect, and it is backed by a great multi-talented team with ultimate potentials. Together this company will drive to take on the most challenging of projects.

Within a short span of less than a decade, this company has made it mission and become one of the most reliable forces in the industry, by mobilizing they edge of technical expertise to transform every projects assigned into a benchmark of excellence.

2.3.2 Vision

Preserver Bina Sdn. Bhd. aims to keep getting better and stay ahead.

2.4 Company Organizational Chart

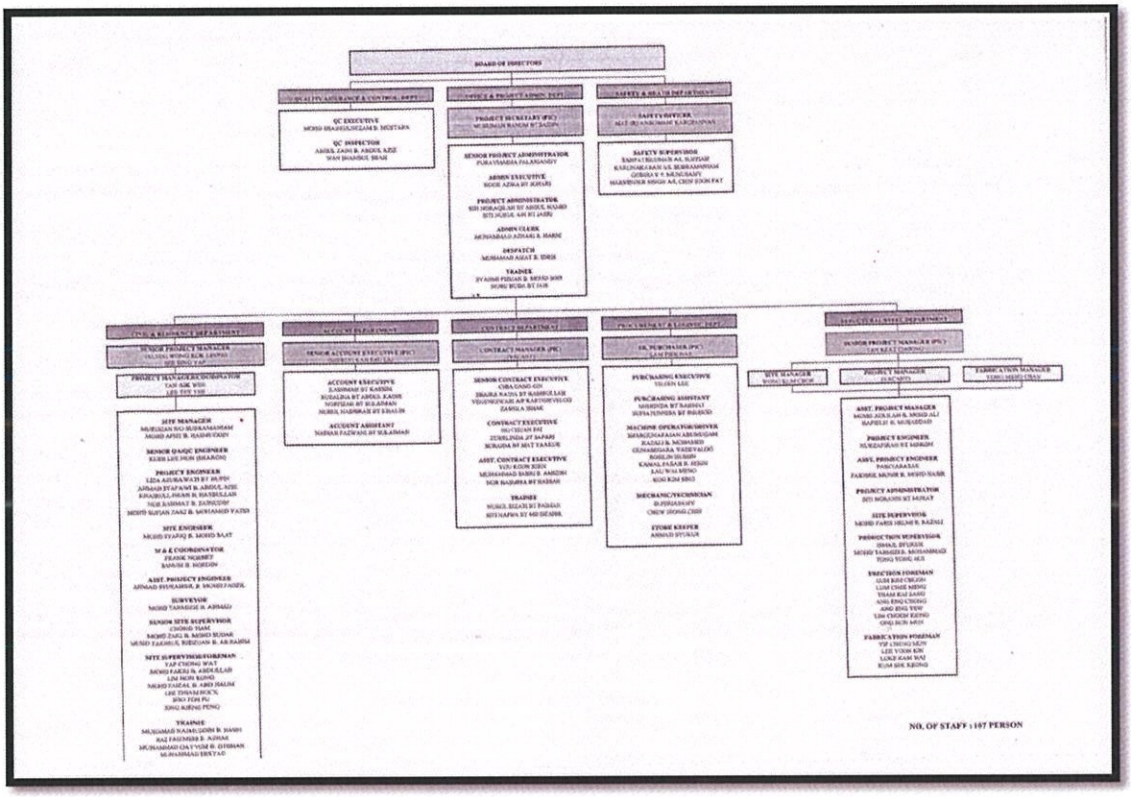


Diagram 2.1: Company Preserver Sdn. Bhd. Organizational chart

2.5 List of Projects

2.5.1 Projects On-going

Table 2.5.1 List of On-Going Projects

Bil	Project	Contract Value (RM)	Completion Date
1.	**Nilam Tekad Sdn. Bhd.** Proposed Developed The Process Plant & Warehouse At Jln. Sg. Pinang 4/2 Pulau Indah Industrial Zone, Pulau Indah, Klang, Selangor, Darul Ehsan.	700,000.00	30.04.2013
2.	**DRB-Hicom Defence Technologies Sdn. Bhd** Proposed Upgrading Of Manufacturing Maintenance Repair And Overhaul (MRO) And Office Facalities At Deftech Pekan, Pekan, Pahang Darul Makmur.	265,000.00	07.04.2013
3.	**Defense Services Sdn. Bhd, Nilai** Proposed Upgrading Pf Manufacturing Maintenance Repair & Overhaul (MRO) And Office Facalities At DSSB Nilai, Negeri Sembilan Darul Khusus.	183,000.00	29.03.2013
Bil	Project	Contract Value (RM)	Completion Date

4.	**Datin Sri Azian bt.Abdul Talib** Proposed To Build A 3 Storey Bungalow House With Swimming Pool At Pt 2995 And Pt 2669 (Lot 6056), Jln. 7 Kemensah Height, Mukim Ulu Kelang, Daerah Gombak, Selangor Darul Ehsan.	550,000.00	01.03.2013
5.	**Hicom- Automotive Manufacturers (M) Sdn. Bhd.** Proposed Development Volkswagen Facilities for Hicom Automotive, Pekan, Pahang Darul Makmur	250,000.00	12.12.2012

Sources: Preserver Bina Sdn. Bhd. (2012)

2.5.2 Projects completed

Table 2.5.2 List of completed projects

Bil	Project	Contract Value (RM)	Completion Date
1.	**Pentamaster Perlis Northern Corridor Factory** Proposed Single Storey Factory On Plot, Taman Teknologi Pauh, Kurong Anai District, Perlis.	RM 22.60 Million	June 2011
2.	**APM Spring- Pendamaran** Proposed Development of Single Storey Factory, with an Electric Sub-Station, a Sewage Treatment Plant, at Jln Raja Lumu, Kg Baru Perdamaran, Klang Selangor	460,000.00	30.03.2012
3.	**Port Dickson Learning Centre (PDLC)** Proposed Development Learning Center At Lot 1888, Mukim Pasir Panjang, Daeran Port Dickson, Negeri Sembilan, Darul Khusus.	380,000.00	12.02.2007

Bil	Project	Contract Value (RM)	Completion Date
4.	**Management Science University (MSU)** Proposed Construction At MSU (Management Science University) At No.4 Persiaran Olahraga, Seksyen 13, 40100, Shah Alam, Selangor, Darul Khusus.	2,700,000.00	12.01.2012
5.	**Valser Oil & Gas Factory, Nilai** Proposed Valser HQ Office And Factory At PT 1082 (Lot 3), Nilai Utama, Mukim Sentul, Daerah Seremban, Negeri Sembilan, Darul Khusus.	400,000.00	30.12.2011
6.	**Samudera Kimia Industries** Proposed Construction At Open Warehouse At Pt 49766, Jln Lengkuk Keluli 2 (KU2). Mukim Kapar, Daerah Klang, Selangor Darul Ehsan.	200,000.00	30.10.2011

Bil	Project	Contract Value (RM)	Completion Date
7.	**Auto Part Manufacturers Co. Sdn.Bhd.** Proposed Construction For Office Renovation At Lot 600, Jln Raja Lumu, Kws. 12, Kaw. Perindustrian Pendamaran, Pelabuhan Klang, Selangor, Darul Ehsan.	150,000.00	01.08.2011
8.	**Barny Callebaut Factory** Proposed Factory At Lot 2, Lebuh Sultan Muhammed 1, Kaw. Perindustrian Bandar Sultan Sulaiman Pelabuhan Klang, Selangor, Darul Ehsan.	350,000.00	30.17.2011
9.	**Sipro Plastic Industries Sdn. Bhd.** Proposed Construction Office And Factory At Pt 7422, Lot 9399, Jln. Jasmine, Kaw. Perindustrian Bukit Beruntung, Mukim Serendah, Section 20, Daerah Hulu Selangor, Selangor Darul Ehsan.	100,000.00	25.05.2011

Bil	Project	Contract Value (RM)	Completion Date
10.	**Madam Esther Ng** Proposed To Build 1 Unit Of 2storey Bungalow At No.13, Jalan BK 6B/13, Banfar Kinrara, Puchong, Selangor Darul Ehsan.	250,000.00	25.03.2011
11.	**Madam Lai Shuh Bin** Proposed To Build 1 Unit Of 2 Storey Bungalow At Jalan Setia Nusantara U13/22C, Setia Eco Park, Section U13, Shah Alam, Selangor Darul Ehsan.	320,000.00	15.01.2011
12.	Proposed To Build 4 Units 3 storey Semi-Detached House, Lot 27695, 27696, 27697, 27698, Taman Gembira, Jalan Kuchai Lama, Petaling Jaya, Selangor, Darul Ehsan.	550,000.00	04.03.2011
13.	Proposed To Build Bungalow 1 Storey Above Street Level Which Contains A Swimming Pool And Guard House At Lot 27978, Junction Tunku, Bukit Tunku, Kuala Lumpur.	250,000.00	03.01.2010

Sources: Preserver Bina Sdn. Bhd. (2012)

CHAPTER 3

INSTALLATION OF STEEL JOINTING USING WELDING METHOD

3.1 Introduction

Image 3.1 Steel Structure

Steel are one of important elements in construction fields. It shares the same root of function for better infrastructure value, strong structure, simple and light weight within a building. As we know steel have various type of design, function and others. But, this report will only review on the method of steel installation such as welding.

Through the method mentioned above, the completeness and strength of steel structures can survive for a long time without affecting other civil structures. Besides, bolts and nuts this is the familiar use of the world market. While welding is a method that is simple, but there are also dangerous because it requires a safety device

especially the eyes and hands. This is because the rate of electrical welding using very high voltage and light or sparks fire can harm the eyes and other body parts.

In addition, this report will comprehensive guide to all aspects of welding or bolts and nut work from initial planning to finish work. This report will also come out with complete guidance and understanding the tools needed to be used in every aspect of procedure to get a proper installation of steel in site using welding.

3.2 Background of project

Image 3.2 Site Project

Project name is Preserver Bina Sdn. Bhd. This project which is to to "Propose to Developed Additional Factory from 'Oleo Chemical' that included the SME Dry Plant, cooling room, SME Wet, Storage & Tower Room, Pipe Rack, Hydrogenation 7 storey and ME Distallation 6 Storey" is located at Section 5, Fasa 2D, Pulau Indah Industrial Park, Jalan Sungai Pinang 5/18, 42920 Pulau Indah, Selangor, Darul Ehsan.

It is contain 1 block of single-storey warehouse including workshop, 1 block of single-storey warehouse with Mezzanine floor and 5-storey Tipping tower, 1 block of

4-storey Administration building, 1 unit of Canteen/ Surau/ and Driver's room, 2 unit of Guardhouse and Weighbridge, 1 unit of TNB (Tenaga Nasional Berhad) building, 1 unit of Effluent Treatment Plant block, 1 unit of Recycleable Material block, 1 unit of Effluent Treatment Material block, 1 unit of Natural Gas Storage, 1 unit of Hydrogen Gas Storage, 1 unit of Refuse Chamber, and last but not least Parking lot for car and motorcycles with roofing.

3.3 CASE STUDY

3.3.1 Welding work procedure

Detailed welding procedures for typical structural welding of plates, shapes and tubular members are to be established and qualified in accordance with the specified standards / codes for WPQ, the requirements of AWS shall prevail. All non-prequalified welding procedure shall be submitted for the Engineer's approval. Upon receipt of Engineers Approval, these welding procedures with the relevant test data are to be submitted for approval. Submission shall be made on standard "Request for Alternate Material or method of Construction" forms in triplicate. The procedures for qualification are to stimulate as far as is practicable, the conditions and materials to be used for production welding. Limitation imposed by the essential variable of the procedure qualification is to be adhered to in production welding. Parameters in welding procedures specifications. Welding Procedures Specifications (WPS) shall contain the following parameters:-

a) Material specification of the base metal to be joined by welding
b) Welding process, manual or machine
c) Plate thickness range for which the procedure is approved
d) Geometry of welding groove showing allowable tolerances including sketch
e) Welding position and direction for vertical welding

f) Filler metal specifications, composition and size

g) Temperature and time adopted for drying and baking of welding consumables before use

h) Gas shielding – Flow, mixture, composition

i) Number and arrangement of runs and weld dimensions (Sketch)

j) Welding current, voltage polarity

k) Travel speed or electrode run-out length for each pass and range

l) Back-gouging and method

m) Pre-heat and inter pass temperature

n) Post weld heat treatment

o) Other variables as specified in AWS D1.1

The essential variables in WPQ is the welding procedure qualifications are to be set up as new WPS and be re-qualified when and changes in the essential variable list in AWS D1.1 are affected. Inspection of weld for WPQ test :-

a) Dimensions of test pieces shall be sufficient to provide for all the required tests as per specified codes / standards or as per AWS requirements.

b) The inspection and test shall be to the required specifications or in the absence of these specifications to AWS D1.1

Procedure Qualification Records is the specific facts from the WPQ and the test results are to be submitted to the endorsement and then to QA/QC section for documentation.

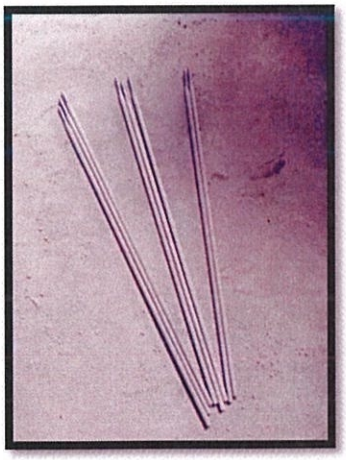
3.3.2 Welder qualifications

All welders and welding operators are to be qualified in accordance with the requirements of the specified standards / codes qualification will be to AWS specification for welders' qualification. Tests to AWS specifications will be as required in actual production works. No welders are to be allowed to proceed with production welding work on a specific project unless he had been qualified to weld on the project. Welders and welding operators are to be re-qualified to the specified standards /codes. The records of welders' qualification test, including a reference to the corresponding WPS and the test results are to be submitted to the QA/QC Person In charge for endorsement and to QA/QC section for documentation

3.3.3 Consumables

Consumables used for production welding are to comply with the following unless client's requirements differ in which case the client's specified. Handling of Electrodes and flux:-

- Electrodes



Images 3.3.3 Electrode

Table 3.3.3 Electrodes Dry Condition

Electrodes Drying Conditions		
Electrodes	Drying Temperature	Keep Period
E 6013	70° - 100°C	30 - 60 minutes

Welding rods shall be used immediately after opening. If leaving in the air for a long time (more than 4 hours for low hydrogen type and more than 8 hours for another type), welding rod shall be dried up again. Re-drying of electrodes shall be no more than one time. Electrodes that have been wet shall not be used. Welders shall take out only such an amount of welding rods that they can use and put into a clean case. All Hermetically sealed electrodes shall be stored in a cool dry area and before being used, take care not to mistake the type of electrode.

- Wire and Flux

When flux is collected, take care not to enter foreign material, such as rust, dirt, etc. Flux being left more than eight hours in the sir shall be dried up again. Rusted wire must not be used. Custody condition of welding rod :-

Temperature : 16° to 38° C

Humidity : Less than 50%

3.3.4 Permissible Conditions For Welding

Welding work shall not be permitted under the following circumstances are atmospheric temperature is lower than O F (- 17.8 C), the surface of weld joint is wet, the surface of weld joint is exposed to rain or snow or strong wind, welders are exposed to a bad weather condition (Mainly inclement weather), weld joints are not preheated sufficiently, electrodes or flux are not dried sufficient.

3.3.5 Preparation For Welding

Figure 3.3.6 welder with the safety tools

For the first is cleaning of weld joint. Each weld joint shall be cleaned and free of foreign material such as paint, oil, rust, dirt, mill scale, slag, moisture, etc. Gas–notches and scale due to gas cutting shall be removed by wire–brush and grinder. Next is drying up of weld joint. The weld joints shall be dried up (by using gas burner, if necessary) before welding, and shall be kept in dry condition throughout welding operation.

3.3.6 Edge Preparation

Edge preparation surface shall be ground smooth. Tolerance of groove angle, root opening and misalignment of butt joint shall be in accordance with the specified standards/ codes. Root opening of fillet weld joints. Root opening shall be less than 1.5mm.In case root opening is 1.5mm to 4.5mm; leg length shall be increased equally.

3.3.7 Preheating

In the case of both tack welding and final welding by manual arc welding, the temperature for preheating shall be selected from the following table based on the thickness plate of weld joints. In case the temperature of base metal is lower than 41°F (5°C), the weld joint shall be preheated more than 70°F (21°C). Preheating the temperature are minimum and temperature above the minimum shown is required for highly restrained welds.

3.3.8 Tack Welding

Assembles of weld joints shall be aligned and held in place by tack welding. In the case of assembling of important strength members, it is desirable that strong backs instead of tack welding shall be fitted to maintain proper alignment of weld joint. Edge surface shall be always cleaned and free of oil, paint, rust, moisture, etc. Any defects by tack welding such as undercut, blowhole, crack, etc. shall be avoided. Qualification for tack welding technique is tack welding shall also be executed by the qualified welders (For high tensile & Special plates) as per item 2. The electrodes for tack welding where the electrodes having smaller diameter (4mm dia. or 3.2mm dia.) than the electrodes to be used for final welding shall be applied to tack welding.

For length and pitch of tack welding bead, especially for avoiding tack welds from rapid cooling and causing a defect, tack welding bead shall be intermittent – welded 30mm long minimum for mild steel and 50mm long minimum for high strength steel. Preheating shall be executed for tack welding. Refer to section 7 about the temperature for preheating.

3.3.9 WELDING SEQUENCE AND 'WAITING'

All weld joints shall be welded in sequence so as to let shrinkage due to welding heat escape from joint. Best welding sequence shall be considered in order not to restrain shrinking within the same plane. Weld joint considered as most shrinkage shall be welded in advance and less shrinkage joint shall be welded last.

3.3.10 EXECUTION OF BUTT WELDING

Tab pieces shall be fitted up at both ends of butt weld joints so as to avoid any defect that is apt to come out at the starting point and the terminal point of welding bead.Back running (root running) of butt weld joint by means of manual metal arc welding shall be done after back chipping as far as sound penetration appears. A crack and slag inclusion should not be developed.

Back chipping shall be done by means of arc-air gouging. Back chipped groove where slag remains shall be ground and wire-brushed so as to remove slag completely. Pay attention to avoid bending especially to butt weld joints. All slag of primary layer shall be removed completely, then the next bead shall be run. The height of reinforcement of weld shall be as follows :-

Table 3.3.10 The height of reinforcement of weld

Base Metal Thickness	Reinforcement (Max)
T < 9.5mm	2.4mm
T > 9.5mm	3.2mm

3.3.11 Repairing Of Other Defects

All weld defects such as slag inclusion, blowhole, insufficient fusion, overlap, etc. shall be removed by arc-air gouging and welded again. Electrodes for repair welding shall be less than 4mm in diameter. Preheating shall comply with the requirements. There are two of repairing of harmful uniform bead and reinforcement:-

(a) Acceptable weld bead

Reinforcement of weld (Excess metal) shall comply with section AWS D1.1. Excess metal height of welded bead shall be limited to the extent as stated in item (i) above. Ruggedness of welded bead height shall be within plus or minus 3mm. Roughness or welded bead height shall be within plus and minus 1mm.

(b) Weld beads deviated from the above requirements shall be corrected be means of grinding, etc.

(c) Weld bead having insufficient width or height shall be welded additionally where necessary. Applicable diameter of welding rods shall be less than 4mm dia.. Preheating shall comply with the requirements.

3.3.12 Acceptance Criteria

Acceptance Criteria are to conform to the specified standard codes.

3.3.13 Inspection

Image 3.3.13 Painting or Finishing

Inspection on all production weldment are to be carried out in accordance to Client's requirements. Usually client is really the welder do the finishers like the picture above.

3.3.14 Documentation

All welding inspection records whether in-house or third party is to be submitted to the QA/QC Person In charge for endorsement.QA/QC section shall collect the inspection records duly endorsed by the QA/QC Person In charge for filing in the Project Inspection File.

3.3.15 Tools of Welding

Images 3.3.16 SMAW

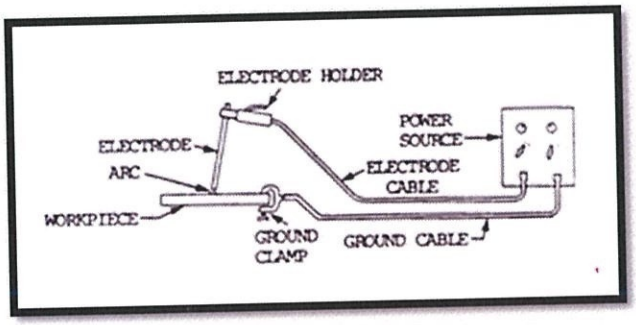
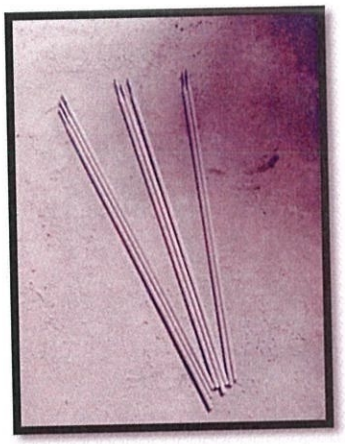


Diagram 3.3.16 SMAW system setup



Images 3.3.16.3 Electrode

Shielded metal arc welding equipment typically consists of a constant current welding power supply and an electrode, with an electrode holder, a ground clamp, and welding cables (also known as welding leads) connecting the two.

Figure 3.3.16.1 Welder

A welder or welder operator is a tradesman who specializes in welding materials together. The term welder refers to the operator, the machine is referred to as the welding power supply. The materials to be joined can be metals (such as steel, aluminum, brass, stainless steel etc.) or varieties of plastic or polymer. Welders typically have to have good dexterity and attention to detail, as well as some technical knowledge about the materials being joined and best practices in the field.

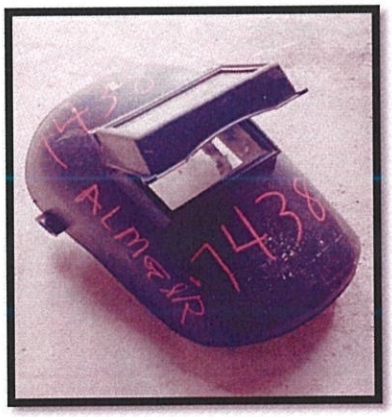


Image 3.3.16.2 Face cover

Image 3.3.16.4 Hand Cover

Welding are also need the safety equipment for a welder. As shown above, these are the several safety tools such as face cover and hand cover to avoid the spark from the welding process.

CHAPTER 4

CONCLUSION AND RECOMMENDATION

4.1 Recommendations

4.1.1 Provide a sufficient tools and machineries

A proper work of installation will definitely need a proper skill of labour and sufficient tools and machineries to do it. As we know all these tools will need to be sufficient enough to make a work become more easy and fast. This is because, not only the installation of work will requires the tools and machineries but some time the workers will be divided into two groups which is one for installation and the other one will need to do some repairing and modifying works if requires to do so. If the tools and machineries are not providing sufficiently enough therefore, all the works that should be complete early will be delayed or postpones.

4.1.2 Provide more workers, which half is for fabrication work and the other half is for site installation work

In this company, I'm aware that the time schedules for workers are not properly organized by supervisor due to lack of workers recruited. This company should be more aware and provide more workers with a proper time schedule work. As we know this kind of work will need a two group of workers which can be divided into fabrication work at factory and site installation work at site. So with a proper time schedule work and sufficient workers the installation work now can be more ease and without any problems.

4.2 Conclusion

As a conclusion, from this case study the writer can literally discuss the details information about installation of steel using the welding method are more better and tougher. As we know steel erection likely welding is one of important element in any kind of projects that's using steel structure. The main function of this element is to provide better and maintain of steel structure for a long time.

But to provide this kind of proper steel erection, components and elements will become the greatest factor that may affect the main function of steel. For an example, the skills of workers must be consider so that the quality is better. Meanwhile, selecting the material used for weld will give a long lasting durability against corrosion and corrupt. Therefore, with this report content I can understand more about components and elements which will be used for this specific type of steel erection.

Moreover, during the observations almost 5 months at site work, the writer learn that some problems related to our works may come from other people who does it purposely or not, but sometimes with improper installation work from our workers itself could also bring problems or damages towards steel joint or erection. However, this report will help to understand all these problems and solved it by how to use welding for steel erection as well.

REFERENCES

BOOK

Badron Jahiman, (2007). Teknologi Binaan Bangunan, Versi Pertama, Malaysia: Selangor.

Frick Heinz, (1980). Ilmu Konstruksi Bangunan 1, Indonesia: Yogyakarta.

Foster Jack Stroud, (1973). Structure and Fabric, Part 1, London: 4 Fitzhardinge Street.

INTERNET

Scott adams (1974), petervaldivia. January ,27,2012,from http://www.petervaldivia.com/eso/index.php

JKR(2007) Jabatan Kerja Raya Negeri Terengganu, Disember,29,2011, from http://www.jkr.terengganu.gov.my/index.php?mod=viewinfotek&id_itk=7

INTERVIEW

Pani (2010-now), Steel Engineer Department, Preserver Bina Sdn Bhd.

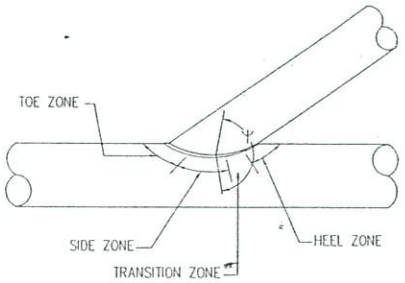
Iranawati (2009-now), Steel Engineer Department, Preserver Bina Sdn Bhd.

APPENDIX

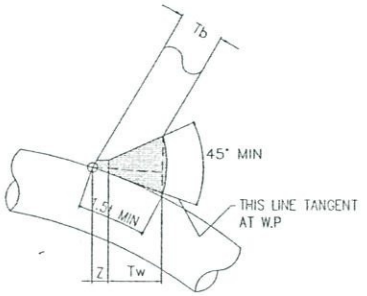
WELDING STANDARD-1

CIRCULAR CONNECTION

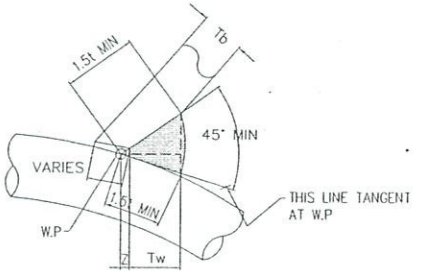
PJP



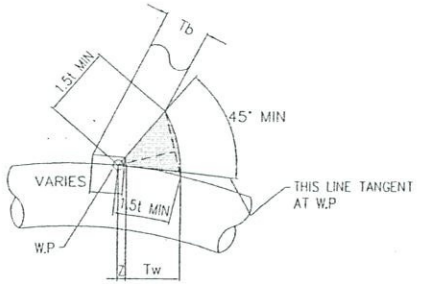
TRANSITION A



TRANSITION B

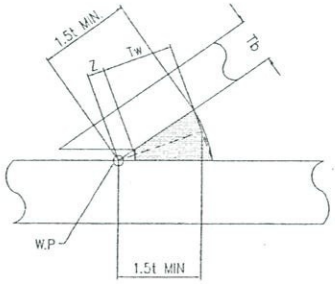


TRANSITION OR HEEL



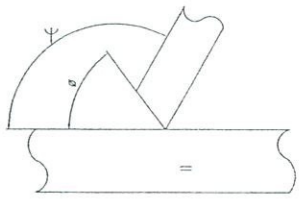
(Ψ =75°–60°)

HEEL



(Ψ =60°–30°)

SKETCH FOR ANGULAR DEFINITION



(150° ≧ Ψ ≧ 30°)
(90°> ø > 30°)

Attn : Mr. Chan

1/2

SHOP DWG

TAJUK CADANGAN:
CADANGAN MEREKABENTUK DAN MEMBINA 1 BLOK PUSAT PAMERAN MATRADE 3 TINGKAT (DOUBLE VOLUME) DENGAN 1½ TINGKAT BASEMEN TEMPAT LETAK KERETA DI ATAS SEBAHAGIAN LOT 50978, JALAN DUTAMAS 2, MUKIM BATU, WILAYAH PERSEKUTUAN KUALA LUMPUR

UNTUK:
TETUAN TTDI KL METROPOLIS SDN BHD

PEMAJU: TTDI KL METROPOLIS SDN BHD

PENGURUS PROJEK: NRY ARCHITECTS / PM Link Pte. Ltd.

ARKITEK: RSP

JURUTERA STRUKTUR & AWAM: TY·LIN

JURUTERA PERUNDING MEKANIKAL & ELEKTRIKAL: COTERIE INTERNATIONAL

ARKITEK LANDSKAP: BLC

JURURUKUR BAHAN

KONTRAKTOR UTAMA

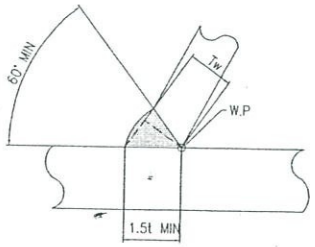
SUB KONTRAKTOR UTAMA

TAJUK LUKISAN: WELDING STANDARD-1

FILE NAME :			
SCALE : NONE		DRAWN BY : C.S.K	
DATE : 17.02.2014		CHECKED BY :	
JOB NO.	DWG. NO.		REVISION
MEC	CC&S/DEC/2012/SPD/ROOF/W001		0

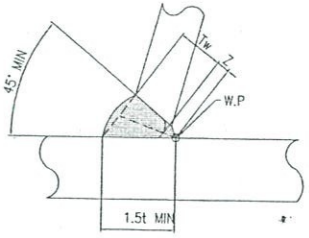
WELDING STANDARD-2

TOE



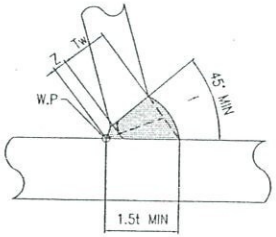
(Ψ =150°–105°)

TOE OR HEEL



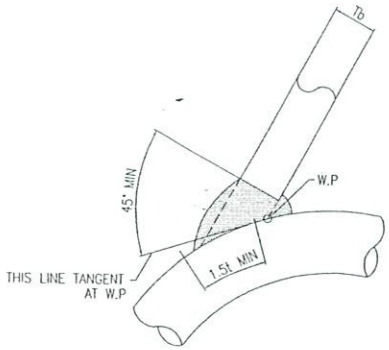
(Ψ =105°–90°)

SIDE OR HEEL

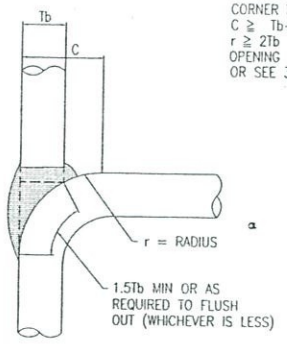


(Ψ =90°–75°)

TOE CORNER



SIDE MATCHED



CORNER DIMENSION
C ≥ Tb+3mm AND
r ≥ 2Tb OR ROOT OPENING ≥ 1.6mm IN. OR SEE 3.12.4.1

NOTE

1. t = THICKNESS OF THINNER SECTION
2. BEVEL TO TEATHER EDGE EXCEPT IN TRANSITION AND HEEL ZONES
3. ROOT OPENING : 0 TO 5mm
4. NOT PREQUALIFIED FOR UNDER 30°
5. WELD SIZE (EFFECTIVE THROAL) Tw ≥ T ; Z LOSS DIMENSIONS SHOWN IN TABLE 2.8
6. CALCULATIONS PER 2.24, 1.3(AWS D1.1) SHALL BE DONE FOR LEG LENGTH LESS THAN 1.5t AS SHOWN
7. FOR BOX SECTION JOINT PREPARATION FOR CORNER TRANSITIONS SHALL PROVIDE A SMOOTH TRANSITION FROM ONE DETAIL TO ANOTHER WELDING SHALL BE CARRIED CONTINUOUSLY AROUND CORNERS WITH CORNERS FULLY BUILT UP AND ALL WELD STARTS AND STOPS WITHIN FLAT FACES
8. SEE ANNEX B FOR DEFINITION OF LOCAL DIHEDRAL ANGLE Ψ
9. WP = WORK POINT

Table 2.8
Z Loss Dimensions for Calculating Prequalified PJP T–, Y–, and K–Tubular Connection Minimum Weld Sizes (see 2.23.2.1)

Groove Angle Φ	Position of Welding: V or OH			Position of Welding: H or F		
	Process	Z (in)	Z (mm)	Process	Z (in)	Z (mm)
Φ ≥ 60°	SMAW	0	0	SMAW	0	0
	FCAW-S	0	0	FCAW-S	0	0
	FCAW-G	0	0	FCAW-G	0	0
	GMAW	N/A	N/A	GMAW	0	0
	GMAW-S	0	0	GMAW-S	0	0
60° > Φ ≥ 45°	SMAW	1/8	3	SMAW	1/8	3
	FCAW-S	1/8	3	FCAW-S	0	0
	FCAW-G	1/8	3	FCAW-G	0	0
	GMAW	N/A	N/A	GMAW	0	0
	GMAW-S	1/8	3	GMAW-S	1/8	3
45° > Φ ≥ 30°	SMAW	1/4	6	SMAW	1/4	6
	FCAW-S	1/4	6	FCAW-S	1/8	3
	FCAW-G	3/8	10	FCAW-G	1/4	6
	GMAW	N/A	N/A	GMAW	1/4	6
	GMAW-S	3/8	10	GMAW-S	1/4	6

SHOP DWG

TAJUK CADANGAN
CADANGAN MEREKABENTUK DAN MEMBINA 1 BLK PUSAT PAMERAN MATRADE 3 TINGKAT (DOUBLE VOLUME) DENGAN 1½ TINGKAT BASEMEN TEMPAT LETAK KERETA DI ATAS SEBAHAGIAN LOT 50978, JALAN DUTAMAS 2, MUKIM BATU, WILAYAH PERSEKUTUAN KUALA LUMPUR

UNTUK
TETUAN TTDI KL METROPOLIS SDN BHD

PEMAJU
TTDI KL METROPOLIS SDN BHD

PENGURUS PROJEK
NBY ARCHITECTS
PM Link Pte. Ltd.
PMLink

ARKITEK
RSP

JURUTERA STRUKTUR & AWAM
T-Y-LIN

JURUTERA PERUNDING MEKANIKAL & ELEKTRIKAL
COTERIE INTERNATIONAL

ARKITEK LANDSKAP
BLC

JURUKUR BAHAN
JUPEM

KONTRAKTOR UTAMA
DAEWOO Engineering & Construction Co. Ltd

SUB KONTRAKTOR UTAMA
HAESONG Engineering Co. Ltd

TAJUK LUKISAN :
WELDING STANDARD-2

FILE NAME :	
SCALE : NONE	DRAWN BY : CJK
DATE : 17.02.2014	CHECKED BY :
JOB NO.	DWG NO. / REVISION

GENERAL NOTES AND LEGENDS OF STEEL STRUCTURES

1. THE FABRICATION AND INSTALLATION OF STEEL TRUSSES UNDER THIS CONTRACT SHALL COMPLY WITH THE CONSTRUCTION SPECIFICATION.
2. STRUCTURAL STEEL MEMBERS AND PLATES SHALL BE NEW PRODUCTS OF BS 4360 GRADE 43A AS SPECIFIED IN THE DESIGNDRAWINGS UNLESS NOTED OTHERWISE. STEEL PIPE AND STEEL TUBING SHALL COMPLY TO BS 1775.
3. STEEL SHALL BE SELECTED TO SATISFY THE BRITTLE FRACTURE REQUIREMENTS IN SECTION 2.4.4 OF BS 5950-1:2000 AT THE SPECIFIED MINIMUM SERVICE TEMPERATURES. THE PLATE THICKNESS FOR STEEL GRADES WITH PRODUCER GUARANTEED CHARPY IMPACT VALUES SHALL NOT EXCEED THE MAXIMUM THICKNESS CALCULATED ACCORDING TO THE PROVISIONS OF BS5950-1:2000 SECTION 2.4.4 FOR STEEL MATERIAL CLASS OF IMPACT PROPERTIES, REFER TO STEEL SPECIFICATION.
4. THE CONTRACTOR SHALL UNDERSTAND THE DESIGN DRAWINGS PRIOR TO THE BEGINNING OF THE WORK. IF THERE ARE ANY QUESTIONS OR INCONSISTENCIES ABOUT MEMBER SIZES, PLAN, ELEVATION AND DETAIL, HE SHALL SUBMIT THE QUERIES TO THE ENGINEER FOR EXPLANATION OR REVISION.
   THE CONTRACTOR SHALL BEAR THE FULL RESPONSIBILITY AS A CONSEQUENCE OF MIS-INTERFRETING THE DRAWINGS.
5. THE CONTRACTOR SHALL COMPLY WITH THE CONSTRUCTION SPECIFICATIONS AND SUBMIT THE CONSTRUCTION DETAIL PLANS/SHOP DRAWINGS BEFORE COMMENCING THE WORK. THE MEMBER SIZES OF ALL STEEL GIRDERS AND STEEL MEMBERS SHALL BE CALCULATED FROM THE VERTICAL & TRANSVERSE SLOPES OF THE TRUSS, ELEVATIONS AND CAMBERS. THE CONTRACTOR SHALL SUBMIT THE SHOP DRAWINGS FOR ENGINEER'S APPROVAL. THE SHOP DRAWINGS SHALL INCLUDE MEMBER SIZES AND LOCATIONS, CONNECTION DETAILS, MATERIAL SPECIFICATIONS, WELD SYMBOLS, HIGH-STRENGTH BOLTS, SIZES AND TYPES OF CONNECTING MEMBERS, AND CONTACT SURFACE WORK, ETC.
   THE CONTRACTOR SHALL ALSO SUBMIT THE ESTIMATE OF STEEL DISTORTION DUE TO WELDING AND INSTALLATION FOR ENGINEER'S APPROVAL.
6. THE CONTRACTOR SHALL MAKE THE IMPROVEMENT PLAN TO PREVENT RESIDUAL STRAINS, DISTORTION,SHRINKAGE AND DEFECT OF THE WELD. THE CONTRACTOR SHALL SUBMIT ADEQUATE WELD METHOD, AND WELDING PROCEDURES FOR ENGINEER'S APPROVAL TO INSURE GOOD WELD QUALITY PRIOR TO BEGINNING OF WORKS.
7. THE CUTTING AND WELDING WORKS OF THE STRUCTURAL MEMBERS SHALL BE DONE IN THE MANUFACTURER'S WELL EQUIPPED FACTORY,PRIOR TO DELIVERING THE MEMBERS TO THE FIELD FOR INSTALLATION. FIELD WELDING IS GENERALLY NOT PERMITTED EXCEPT WHERE FIELD WELD SYMBOL, ⚐ ,IS INDICATED IN THE DRAWING, OR IS APPROVED BY THE ENGINEER IN WRITING.
8. WHERE DESIGN DRAWINGS INDICATE NO WELD SYMBOL AND WELD SIZE AT THE CONNECTION, CONTRACTOR SHALL MAKE THE WELDING DETAILS IN THE SHOP DRAWINGS COMPLYING TO THE CONSTRUCTION SPECIFICATION AND SUBMIT TO THE ENGINEER FOR APPROVAL BEFORE COMMENCING THE WORKS.
9. COMBINING TWO SHORT PLATES TO A SINGLE PLATE IS NOT PERMITTED , UNLESS OTHERWISE NOTED AS GROOVE WELD JOINT IN THE DRAWINGS. FOR PLATE WITH LENGTH OVER 12M , THE PLATE CAN BE BUILT UP FROM TWO SHORT PLATES WITH ONE WELDED SPLICE ONLY. THE WELD SHALL BE PLACED AT ALTERNATE LOCATIONS TO AVOID PLATE SPLICE AT A PARTICULAR SECTION . THE CONTRACTOR SHALL SUBMIT CUTTING PLAN TO ENGINEER FOR APPROVAL PRIOR TO THE BEGINNING OF WORKS.
10. THE CONTRACTOR SHALL CONSIDER CONSTRUCTION SCHEDULE, CONSTRUCTION PROGRESS, JOB SITE ENVIRONMENT, ROAD CONDITIONS, TRAFFIC MAINTENANCE AND WEATHER EFFECT. HE SHALL SUBMIT INSTALLATION DETAIL PLAN FOR ENGINEER'S APPROVAL. THE PLAN SHALL INCLUDE DETAIL SHOP DRAWINGS AND CALCULATIONS OF MEMBER TRANSPORTATION, STORAGE PLAN, INSTALLATION METHOD AND SEQUENCE, MECHANIC FUNCTION AND LOCATION OF INSTALLATION, AUXILIARY SUPPORTS, AND CONSTRUCTION SAFETY PROTECTION.
11. THE METHOD ON THE ASSEMBLAGE AND INSTALLATION OF THE TRUSSES SHALL BE DETERMINED BY THE CONTRACTOR WHICH DEPENDS ON THE FACTORS OF EQUIPMENT AND CAPACITY, DEAD LOAD CAMBER AND DEADLOAD STRESS IN THE DESIGN ARE CALCULATED ON THE FINISHED CONDITION OF THE TRUSS EXCEPT FOR THE COMPOSITE GIRDERS OR NOTED OTHERWISE. TEMPORARY SUPPORT SHALL TAKE THE SELF-WEIGHT OF THE TRUSSES. CHORD MEMBER SHALL BE SUPPORTED BY THE TEMPORARY SUPPORTS AT SUFFICIENT INTERVALS TO CREATE NO STRESS IN THE MEMBER UNDER ITS OWN WEIGHT DURING INSTALLATION. IF CONTRACTOR USE ALTERNATIVE METHOD TO INSTALL, THE CONTRACTOR SHALL SUBMIT INSTALLATION PROCEDURES, MEMBER STRESSES DURING INSTALLATION, AND CAMBER CALCULATION FOR THE ENGINEER'S APPROVAL PRIOR THE BEGINNING OF THE WORK.
12. THE CONTRACTOR SHALL PAINT THE STEEL AND STRANDS COMPLYING TO THE CONSTRUCTION SPECIFICATION.HE SHALL SUBMIT THE SPECIFICATION OF THE PAINT TO THE ENGINEER FOR PRIOR APPROVAL.
13. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE NOTED IN THE DESIGN DRAWINGS.
14. ORDINARY BOLTS OF GRADE 4.6 AND GRADE 8.8 SHALL COMPLY TO BS 4190. HIGH-STRENGTH FRICTION GRIP BOLTS SHALLCOMPLY TO BS 4395.
15. CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF BS 5950
16. WELDING SHALL BE IN ACCORDANCE WITH THE LATEST APPLICABLE BS REQUIREMENTS.
17. METHOD STATEMENT OF STEEL STRUCTURE ERECTION, DESIGN AND CALCULATION FOR RELATED TEMPORARY WORKS INCLUDING QA / QC PROCEDURES MUST BE SUBMITTED ENGINEER'S REVIEW PRIOR TO PHYSICAL WORKS ON SITE.
18. DESTRUCTIVE AND NON-DESTRUCTIVE TESTS TO STRUCTURAL STEELWORKS IS DEEMED INCLUDED IN THE STRUCTURAL STEEL FABRICATION SCHEDULE.
19. FIRE PROTECTION REQUIREMENTS TO ALL STRUCTURAL STEELWORKS SHOULD STRICTLY COMPLY TO RELEVANT BRITISH STANDARD OR ARCHITECTURAL / BOMBA REQUIREMENT.
20. IN THE EVENT OF ANY CONFLICT OR INCONSISTENCIES BETWEEN THE STRUCTURAL STEEL SPECIFICATION AND THE PARTICULAR SPECIFICATION FOR STEEL STRUCTURE IN THE CONTRACT DOCUMENTS, THE PARTICULAR SPECIFICATION FOR STEEL STRUCTURE SHALL TAKE PRECEDENCE.

ALL SECTIONS SHALL CONFORM WITH BS 4 AND BS EN 10034 UNLESS NOTED OTHERWISE.

ABBREVIATIONS:

UB	UNIVERSAL BEAM
UC	UNIVERSAL COLUMN
RSC	ROLLED STEEL CHANNEL
RSJ	ROLLED STEEL JOIST
RHS	RECTANGULAR HOLLOW SECTION
SHS	SQUARE HOLLOW SECTION
CHS	CIRCULAR HOLLOW SECTION
RSA	ROLLED STEEL ANGLE
CFA	COLD FORMED ANGLE
U.O.N.	UNLESS OTHERWISE NOTE
CFW	CONTINUOUS FILLET WELD
FPBW	FULL PENETRATION BUTT WELD
THK	THICK
℄	CENTERLINE
8 PPBW	PART PENETRATION BUTT WELD SIZE OF PART PENETRATION BUTT WELD IN mm
L.V.	LENGTH VARIES
T.L.	TOP LEVEL
T.O.S.	TOP OF STEEL LEVEL
S.O.P.	SETTING OUT POINT

22. MEMBER NOTATIONS:
    BEAM, COLUMN CHANNEL AND JOIST
    UB 305 X 305 X 97
    97 — WEIGHT (kg/m)
    305 — NOMINAL SIZE
    UB — SECTION SHAPE
23. UNLESS NOTED OTHERWISE ALL FILLET WELDS SHALL BE FULL PROFILE, WITH A MINIMUM LEG LENGTH OF 6mm. WELDING CONSUMABLES SHALL PRODUCE DEPOSITED WELD METAL HAVING MECHANICAL PROPERTIES NOT INFERIOR TO THE MINIMA OF THE PARENT METALS.
24. ALL WELDING IS TO COMPLY WITH BS EN 1011-1 AND BS EN 1011-2.
25. UNLESS NOTED OTHERWISE ALL BUTT WELDS SHALL BE FULL PENETRATION.
26. WELDERS SHALL BE TESTED IN ACCORDANCE WITH BS EN 287-1 APPROPRIATE TO THE TYPE OF WELDING THEY ARE REQUIRED TO PERFORM.
27. JOINT DESIGNATION
    1) SYMBOLS FOR JOINT TYPES

B	BUTT JOINT
C	CORNER JOINT
T	T-JOINT
BC	BUTT OR CORNER JOINT
TC	T-OR CORNER JOINT
BTC	BUTT, T-, OR CORNER JOINT

2) SYMBOLS FOR BASE METAL THICKNESS AND PENETRATION

L	LIMITED THICKNESS-COMPLETE JOINT PENETRATION
U	UNLIMITED THICKNESS-COMPLETE JOINT PENETRATION
P	PARTIAL JOINT PENETRATION

3) SYMBOLS FOR WELD TYPES

1	SQUARE-GROOVE
2	SINGLE-V-GROOVE
3	DOUBLE-V-GROOVE
4	SINGLE-BEVEL-GROOVE
5	DOUBLE-BEVEL-GROOVE
6	SINGLE-U-GROOVE
7	DOUBLE-U-GROOVE
8	SINGLE-J-GROOVE
9	DOUBLE-J-GROOVE
10	FLARE-BEVEL-GROOVE

4) SYMBOLS FOR WELDING PROCESSES IF NOT SHIELDED METAL ARC WELDING

S	SUBMERGED ARC WELDING
G	GAS METAL ARC WELDING
F	FLUX CORED ARC WELDING

5) WELDING PROCESSES

SMAW	SHIELDED METAL ARC WELDING
GMAW	GAS METAL ARC WELDING
FCAW	FLUX CORED METAL ARC WELDING
SAW	SUBMERGED ARC WELDING

6) WELDING PROCESSES

F	FLAT
H	HORIZONTAL
V	VERTICAL
OH	OVERHEAD
ALL	ALL

WELDED NOTE

a : NOT PREQUALIFIED FOR GAS METAL ARC WELDING USING SHORT CIRCUITING TRANSFER AND GTAW
b : JOINT IS WELDED FROM ONE SIDE ONLY.
c : CYCLIC LOAD APPLICATION LIMITS THESE JOINTS TO THE HORIZONTAL WELDING POSITION.
d : BACKGOUGE ROOT TO SOUND METAL BEFORE WELDING SECOND SIDE.
e : SMAW DETAILED JOINTS MAY BE USED FOR PREQUALIFIED GMAW (EXCEPT GMAW-S) AND FCAW.
f : MINIMUM WELD SIZE(E) AS SHOWN IN 5.5 AS SPECIFIED ON DRAWING.
g : IF FILLET WELDS ARE USED IN STATICALLY LOADED STRUCTURES TO REINFORCE GROOVE WELDS IN CORNER AND T-JOINTS, THESE SHALL BE EQUAL TO 1/4T1, BUT NEED NOT EXCEED 10mm. GROOVE WELDS IN CORNER AND T-JOINTS OF CYCLICALLY LOADED STRUCTURES SHALL BE REINFORCED WITH FILLET WELDS EQUAL TO 1/4T1, BUT NOT MORE THAN 10mm.
h : DOUBLE-GROOVE WELDS MAY HAVE GROOVES OF UNEQUAL DEPTH, BUT THE DEPTH OF THE SHALLOWER GROOVE SHALL BE NO LESS THAN ONE-FOURTH OF THE THICKNESS OF THE THINNER PART JOINED.
i : DOUBLE-GROOVE WELDS MAY HAVE GROOVE OF UNEQUAL DEPTH, PROVIDED THESE CONFORM TO THE LIMITATIONS OF NOTE E. ALSO THE WELD SIZE (E) APPLIES INDIVIDUALLY TO EACH GROOVE.
j : THE ORIENTATION OF THE TWO MEMBERS IN THE JOINTS MAY VARY FROM 135° TO 180° FOR BUTT JOINTS OR 45° TO 90° FOR T-JOINTS.
k : FOR CORNER JOINTS. THE OUTSIDE GROOVE PREPARATION MAY BE IN EITHER OR BOTH MEMBER, PROVIDED THE BASIC GROOVE CONFIGURATION IS NOT CHANGED AND ADEQUATE EDGE DISTANCE IS MAINTAINED TO SUPPORT THE WELDING OPERATIONS WITHOUT EXCESSIVE EDGE MELTING.
l : WELD SIZE (E) IS BASED ON JOINTS WELDED FLUSH.
m : FOR FLARE-V-GROOVE WELDS AND FLARE-BEVEL-GROOVE WELDS TO RECTANGULAR TUBULAR SECTIONS, r SHALL BE AS TWO TIMES THE WALL THICKNESS.
n : FOR FLARE-V-GROOVE WELDS TO SURFACES WITH DIFFERENT RADII r, THE SMALLER r SHALL BE USED.

8) WELDING SYMBOL

BASIC WELDING SYMBOL		
TYPE		SYMBOL
SQUARE GROOVE WELD	SINGLE	
	DOUBLE	
V SHAPE GROOVE WELD	SINGLE	
	DOUBLE	
BEVEL GROOVE WELD	SINGLE	
	DOUBLE	
J SHAPE GROOVE WELD	SINGLE	
	DOUBLE	
U SHAPE GROOVE WELD	SINGLE	
	DOUBLE	
FLARE-BEVEL GROOVE WELD	SINGLE	
	DOUBLE	
FLARE V SHAPE GROOVE WELD	SINGLE	
	DOUBLE	
FILLET WELD	SINGLE	
	DOUBLE	
PLUG OR SLOT WELD		
BACK WELD		

ADDITIONAL WELDING SYMBOL		
NAME		SYMBOL
BACKING BAR		
SPACER		
WELD ALL AROUND		
FIELD WELD		
WELD SURFACE	FLUSH	
	CONVEX	
	CONCAVE	
WELD EXTRA WORK	CHISEL	C
	GRIND	G
	MILLER	M
	HAMMER	H
	FREE	F

A	2013.09.10

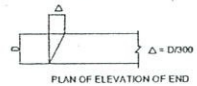
Revision (2013.09.10)

CONSTRUCTION DRAWING

GENERAL NOTES
STEEL STRUCTURE-1

PERMITTED DEVIATIONS IN ROLLED COMPONENTS AFTER FABRICATION

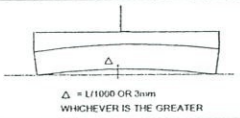
SQUARENESS OF ENDS NOT PREPARED FOR BEARING



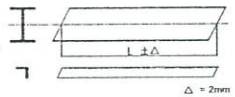
SQUARENESS OF ENDS PREPARED FOR BEARING

Prepare ends with respect to the longitudinal axis of the member.

STRAIGHTNESS ON BOTH AXES

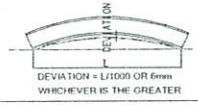


LENGTH



Length after cutting, measured on the centre line of the section or on the corner of angles.

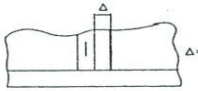
CURVED OR CAMBERED



Deviation from intended curve or camber at mid-length of curved portion when measured with wed horizontal.

PERMITTED DEVIATIONS FOR ELEME. OF FABRICATED MEMBERS

POSITION OF FITTINGS

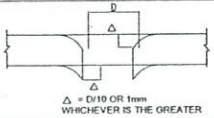


Fittings and components whose location is critical to the force path in the structure, the deviation from the intended position shall not exceed △.

POSITION OF HOLES

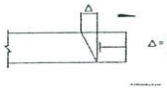
The deviation from the intended position of an isolated hole, also a group of holes, relative to each other shall not exceed △.

PUNCHED HOLES



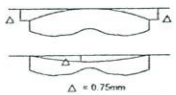
The distortion caused by a punched hole shall not exceed

SHEARED OR CROPPED EDGES OF PLATES OR ANGLE



The deviation from a 90° edge shall not exceed △.

FLATNESS



Where full contact bearing is spcified, the fatness shall be such that when measured against a straight edge not exceeding one metre long, which is laid against the full bearing surface in any direction, the gap does not exceed △.

PERMITTED DEVIATIONS IN PLATE GIRDER SECTIONS

DEPTH

Depth on center line

FLANGE WIDTH

Width of Bw or Bn

Bw or Bn < 300mm
△ = 3mm

Bw or Bn ≥ 300mm
△ = 5mm

SQUARENESS OF SECTION

Out of squareness of flanges

WEB ECCENTRICITY

Intended position of web from one edge of flange

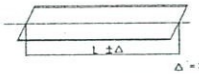
FLANGES

Out of flatness

TOP FLANGE OF CRANE GIRDER

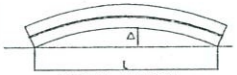
Out of flatness where the rail seats

LENGTH



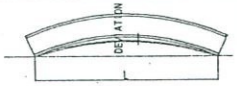
Length on centre line.

FLANGES STRAIGHTNESS



Straightness of individual flanges.

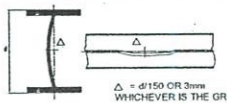
CURVED OR CAMBERED



Deviation from intended curve or camber at mid-length of curved portion when measured with wed horizontal.

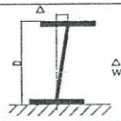
PERMITTED DEVIATI ... I PLATE GIRDER SECTIONS

WEB DISTORTION



Distortion on web depth or gauge length.

CROSS SECTION AT BEARINGS

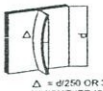


Squareness of flanges to web.

WEB STIFFENERS

Straightness of stiffener out of plane with web after welding.

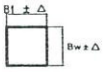
WEB STIFFENERS



Straightness of stiffener in plane with web after welding.

PERMITTED DEVIATIONS IN BOX SECTIONS

PLATE WIDTHS



Width of Bf or Bw

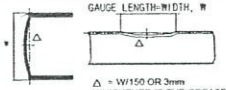
Bf or Bw < 300mm
△ = 3mm

Bf or Bw ≥ 300mm
△ = 5mm

SQUARENESS

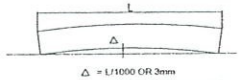
Squareness at diaphragm positions.

PLATE DISTORTION



Distortion on width or gauge length.

WEB OR FLANGE STRAIGHTNESS



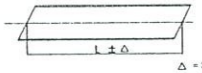
WEB STIFFENERS

Straightness in plane with plate after welding.

WEB STIFFENERS

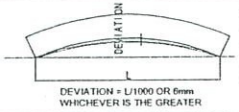
Straightness out of plane to plate after welding.

LENGTH



Length on centre line.

CURVED OR CAMBERED



Deviation from inlended curve or camber at mid-length of curved portion when measured with uncambered side horizontal.

4/4

△ Revision (2013.09.10)

CONSTRUCTION DRAWING

GENERAL NOTES
STEEL STRUCTURE-5

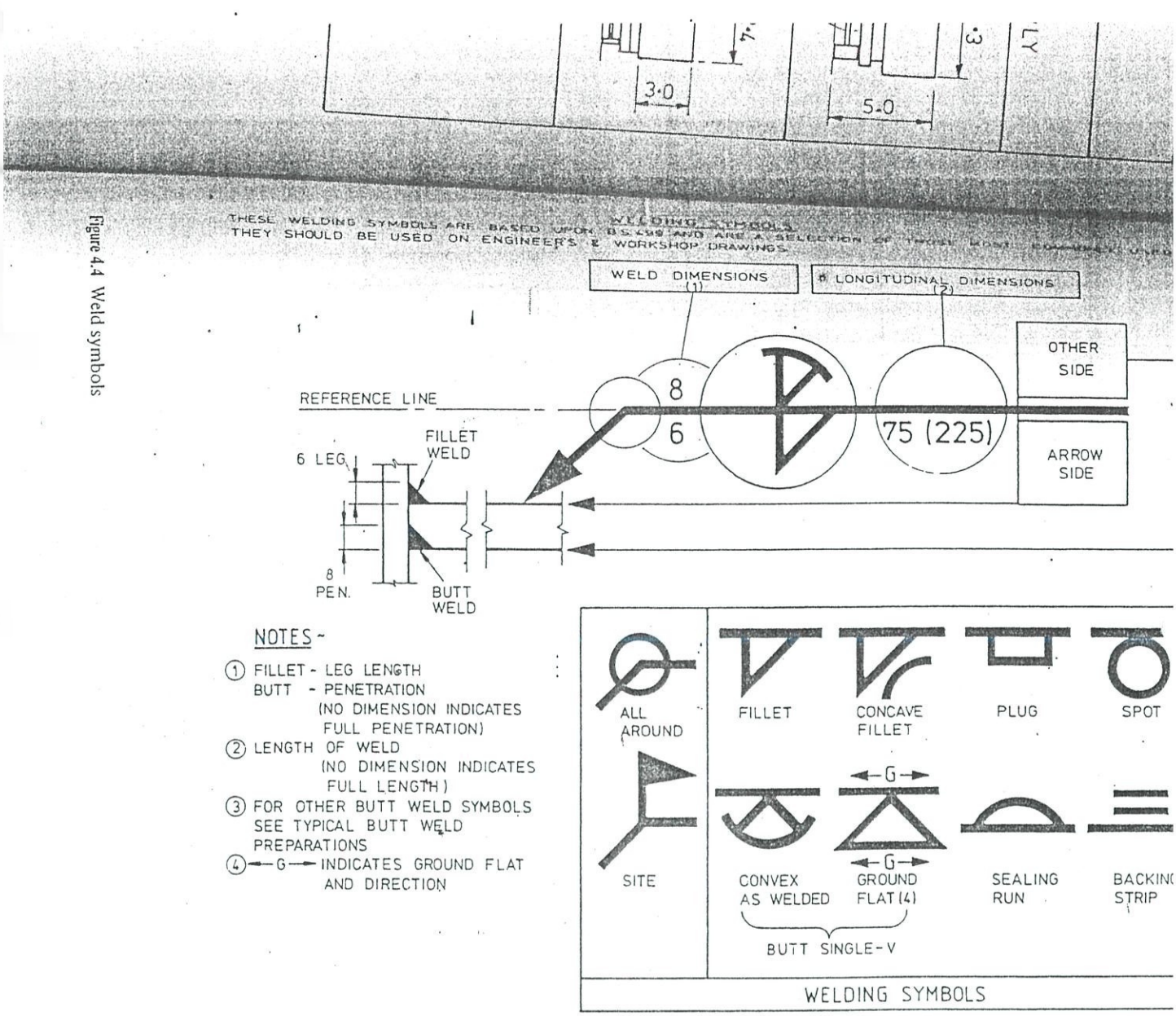


Figure 4.4 Weld symbols

EXAMPLES

	TYPE	DETAIL	SYMBOL		TYPE	DETAIL	SYMBOL
FILLET	ONE SIDE - THIS SIDE		6 / 6 EITHER / 6 OR	BUTT (3)	DOUBLE V GROUND FLAT		G / G
FILLET	ONE SIDE - HIDDEN SIDE		6 EITHER / 6 OR	BUTT (3)	DOUBLE V PARTIAL PEN.	8 / 6	6 / 8
FILLET	INTERMITTENT - BOTH SIDES STAGGERED	150 75 225 75 / 225 75 75	6 (150) 75 (225) / 6 75 (150)		WELD ALL AROUND		6
FILLET	BOTH SIDES	6 LEG / 8 LEG	6 / 8	SLOT	WELDED FROM THIS SIDE	50 100 50	12 50
FILLET & BUTT	ONE SIDE - FILLET OTHER SIDE PARTIAL PEN. BUTT. + FILLET	8 / 6 8	8 / 6 / 8	PLUG		15 ϕ / 150	15 (150)

Figure 4.5 Typical weld preparations

TYPICAL BUTT WELD PREPARATIONS - FULL PENETRATION

THESE DETAILS ARE A TYPICAL SELECTION ONLY CONFORMING WITH THE RECOMMENDED PREPARATIONS IN BS 5135. WELD PREPARATIONS SHOULD NOT BE DETAILED ON ENGINEERS DRAWINGS BUT ARE REQUIRED ON WORKSHOP DRAWINGS

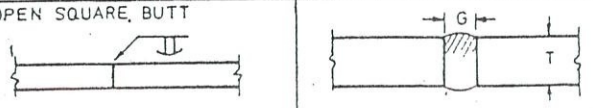
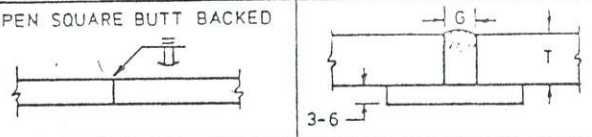
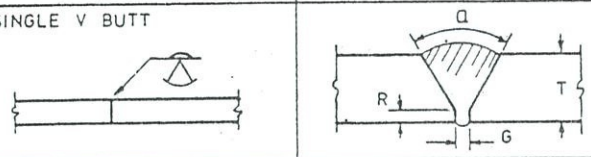
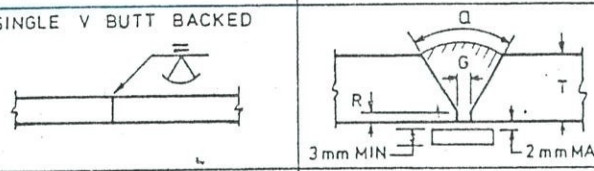
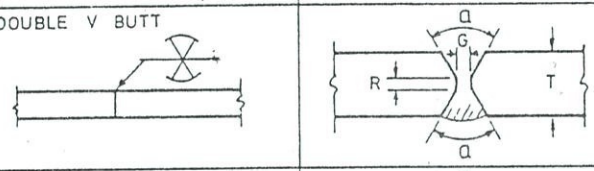
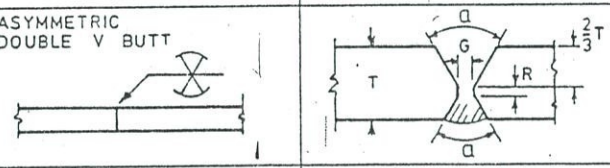
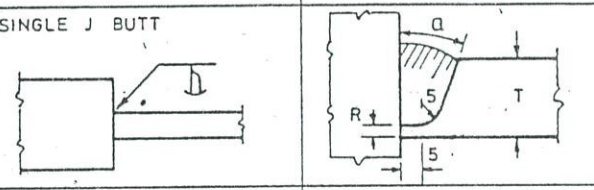
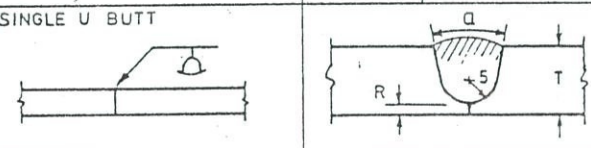
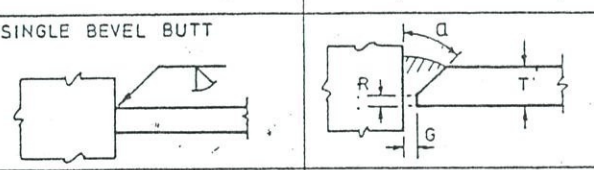
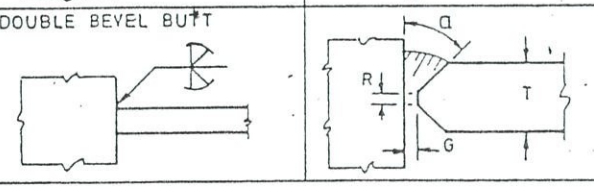
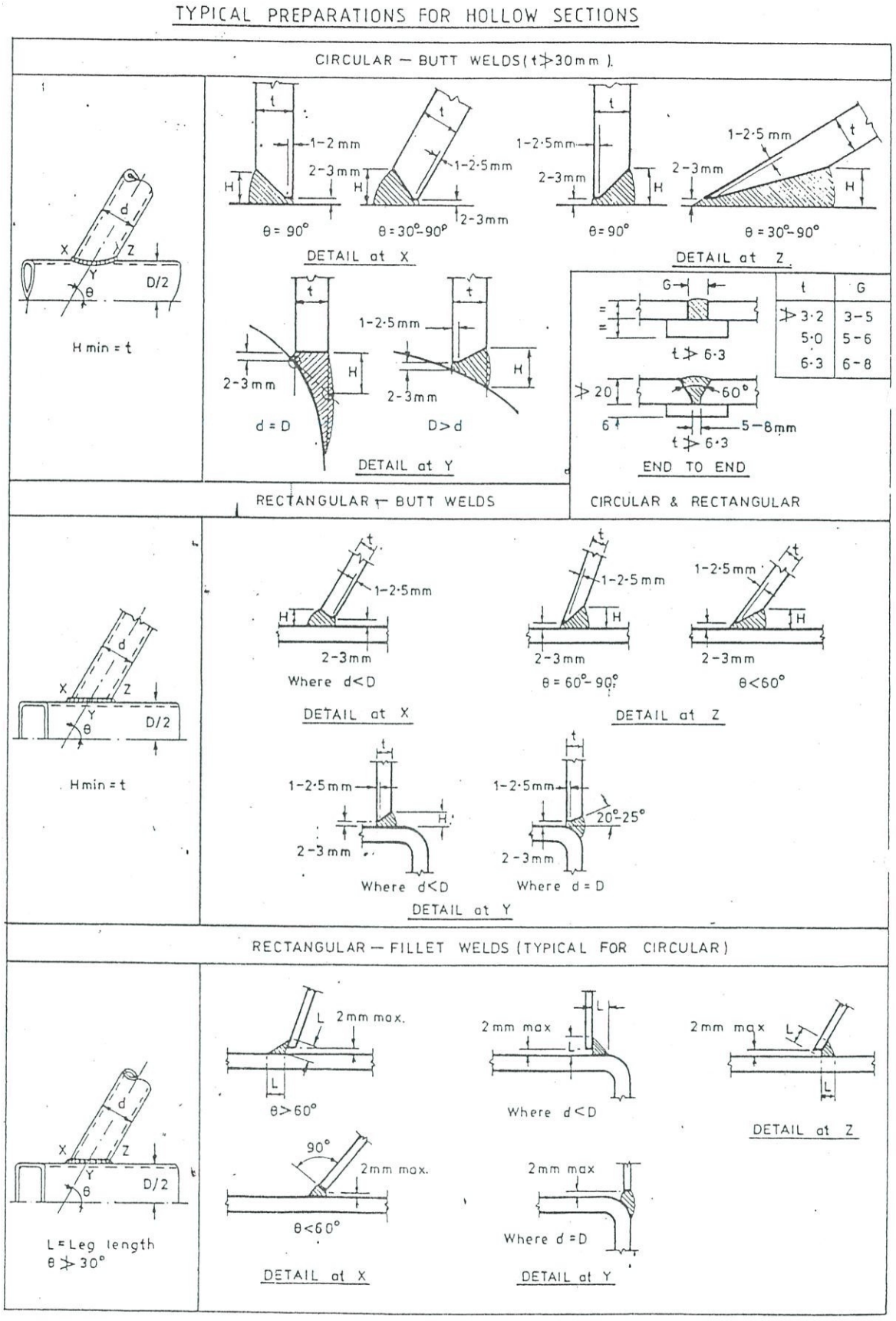
WELD & SYMBOL	DETAIL	THICKNESS T	GAP G	ANGLE α	ROOT FACE R
		mm	mm		mm
OPEN SQUARE BUTT		0 - 3 3 - 6	0 - 3 3	— —	— —
OPEN SQUARE BUTT BACKED		3 - 5 5 - 8 8 - 16	6 8 10	— — —	— — —
SINGLE V BUTT		5 - 12 > 12	2 2	60° 60°	1 2
SINGLE V BUTT BACKED		> 10	6 10	45° 20°	0 0
DOUBLE V BUTT		> 12	3	60°	2
ASYMMETRIC DOUBLE V BUTT		> 12	3	60°	2
SINGLE J BUTT		> 20	—	20°	5
SINGLE U BUTT		> 20	—	20°	5
SINGLE BEVEL BUTT		5 - 12 > 12	3 3	45° 45	1 2
DOUBLE BEVEL BUTT		> 12	3	45	2

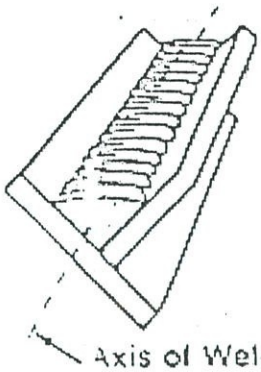
Figure 4.5 *Contd*



Welding positions

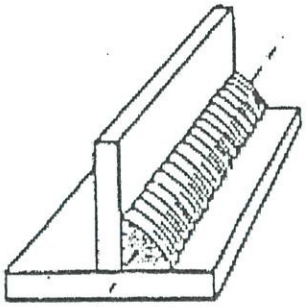
FILLET WELDS

FLAT POSITION
1F



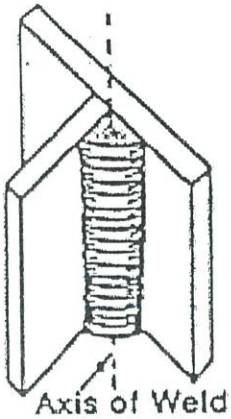
Axis of Weld
Horizontal

HORIZONTAL
POSITION
2F



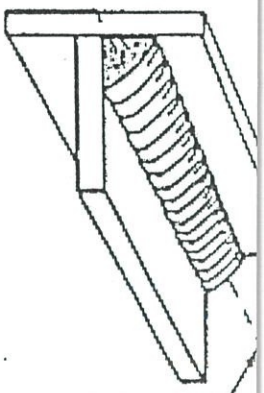
Axis of Weld
Horizontal

VERTICAL POSITION
3F



Axis of Weld
Vertical

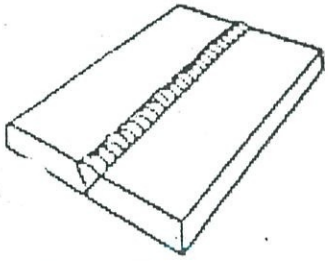
OVERHEAD POSIT
4F



Axis of Weld
Horizontal

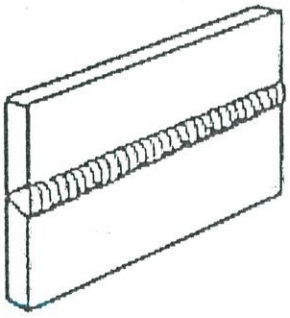
GROOVE WELDS

FLAT POSITION
1G



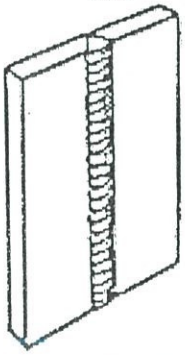
Plates Horizontal

HORIZONTAL POSITION
2G



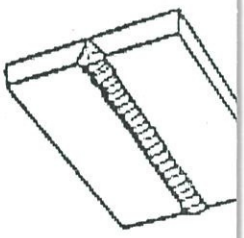
Plates Vertical

VERTICAL POSITION
3G



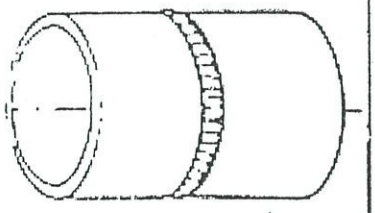
Plates Vertical

OVERHEAD POSIT
4G



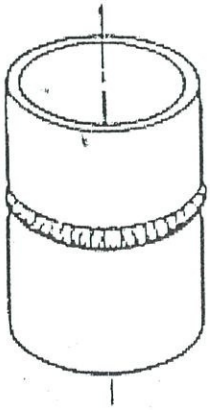
Plates Horizont

FLAT 1G



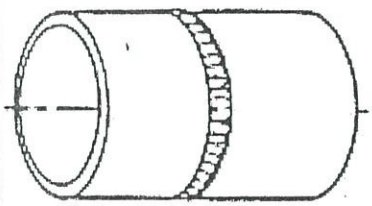
Pipe Shall Be
Turned or Rolled
While Welding
Axis of Pipe Horizontal

HORIZONTAL 2G



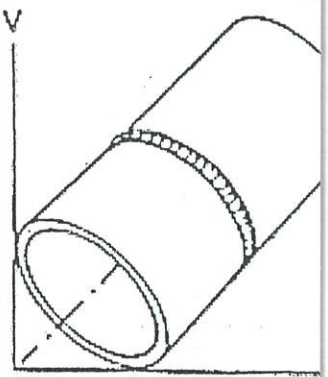
Axis of Pipe Vertical

5G POSITION



Pipe Shall Not Be
Turned or Rolled
While Welding
Axis of Pipe Horizontal

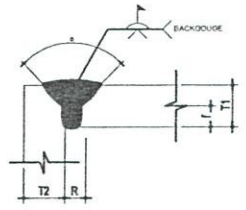
6G POSITION



Inclined Axis With
Pipe Stationary

10 SQUARE-V-GROOVE CJP WELD DETAIL

FOR CORNER JOINT(C)

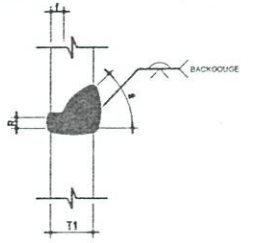


* NOTE
1. ALL DIMENSIONS IN mm
2. SEE 6 FOR WELDED LEGEND
3. √ : REQUIRE, X : NOT REQUIRE

WELDING PROCESS	JOINT DESIGNATION	BASE METAL THICKNESS (U=UNLIMITED)		GROOVE PREPARATION			PERMITTED WELDING POSITIONS	GAS SHIELDING FOR FCAW	WELDED NOTE
				ROOT OPENING ROOT FACE GROOVE ANGLE	TOLERANCE AS DETAILED	TOLERANCE AS FIT-UP			
		T1	T2						
SMAW	C-U2	U	U	R=0 TO 3 h=0 TO 3 a=60°	+2, -0 +2, -0 +10°, -0°	+2, -3 NOT LIMITED +10°, -5°	ALL	-	d, e, g, j
GMAW,FCAW	C-U2-GF	U	U	R=0 TO 3 h=0 TO 3 a=60°	+2, -0 +2, -0 +10°, -0°	+2, -3 NOT LIMITED +10°, -5°	ALL	X	a, d, g, j
SAW	C-U2a-S	U	U	R=0 TO 3 h=6 MAX a=60°	+0, -0 +0, -0 +10°, -0°	+2, -0 +2, -2 +10°, -5°	F	-	d, g, j

11 SINGLE-BEVEL-GROOVE CJP WELD DETAIL

FOR BUTT JOINT(B)

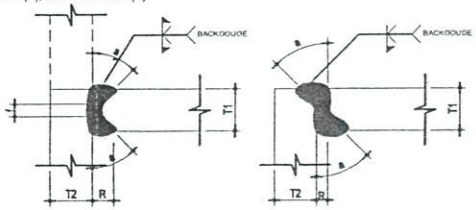


* NOTE
1. ALL DIMENSIONS IN mm
2. SEE 6 FOR WELDED LEGEND
3. √ : REQUIRE, X : NOT REQUIRE

WELDING PROCESS	JOINT DESIGNATION	BASE METAL THICKNESS (U=UNLIMITED)		GROOVE PREPARATION			PERMITTED WELDING POSITIONS	GAS SHIELDING FOR FCAW	WELDED NOTE
				ROOT OPENING ROOT FACE GROOVE ANGLE	TOLERANCE AS DETAILED	TOLERANCE AS FIT-UP			
		T1	T2						
SMAW	B-U4b	U	-	R=0 TO 3 h=0 TO 3 a=45°	+2, -0 +2, -0 +10°, -0°	+2, -3 NOT LIMITED +10°, -5°	ALL	-	c, d, e, j
GMAW,FCAW	B-U4b-GF	U	-				ALL	X	a, c, d, j
SAW	B-U4b-S	U	-	R=0 h=6 MAX a=60°	+0, -0 +0, -3 +10°, -0°	+5, -0 +2, -2 +10°, -5°	F	-	c, d, j

12 DOUBLE-BEVEL-GROOVE CJP WELD DETAIL

FOR T-JOINT(T), CORNER JOINT(C)

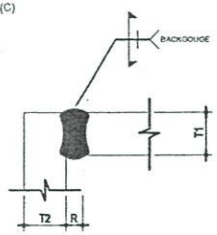


* NOTE
1. ALL DIMENSIONS IN mm
2. SEE 6 FOR WELDED LEGEND
3. √ : REQUIRE, X : NOT REQUIRE

WELDING PROCESS	JOINT DESIGNATION	BASE METAL THICKNESS (U=UNLIMITED)		GROOVE PREPARATION			PERMITTED WELDING POSITIONS	GAS SHIELDING FOR FCAW	WELDED NOTE
				ROOT OPENING ROOT FACE GROOVE ANGLE	TOLERANCE AS DETAILED	TOLERANCE AS FIT-UP			
		T1	T2						
SMAW	TC-U5b	U	U	R=0 TO 3 h=0 TO 3 a=45°	+2, -0 +2, -0 +10°, -0°	+2, -3 NOT LIMITED +10°, -5°	ALL	-	d, e, g, h, j, k
GMAW,FCAW	TC-U5-GF	U	U				ALL	X	a, d, g, h, j, k
SAW	TC-U5-S	U	U	R=0 h=6 MAX a=60°	+0, -0 +0, -3 +10°, -0°	+2, -0 +2, -2 +10°, -5°	F	-	d, g, h, j, k

13 T-GROOVE CJP WELD DETAIL

FOR T-JOINT(T), CORNER JOINT(C)

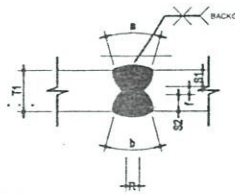


* NOTE
1. ALL DIMENSIONS IN mm
2. SEE 6 FOR WELDED LEGEND
3. √ : REQUIRE, X : NOT REQUIRE

WELDING PROCESS	JOINT DESIGNATION	BASE METAL THICKNESS (U=UNLIMITED)		GROOVE PREPARATION			PERMITTED WELDING POSITIONS	GAS SHIELDING FOR FCAW	WELDED NOTE
				ROOT OPENING	TOLERANCE AS DETAILED	TOLERANCE AS FIT-UP			
		T1	T2						
SMAW	TC-L1b	6 max	U	R=T1/2	+2, -0	+2, -3	ALL	-	d, e, g
GMAW,FCAW	TC-L1-GF	10 max	U	R=0 TO 3	+2, -0	+2, -3	ALL	X	a, d, g
SAW	TC-L1-S	10 max	U	R=0	+0, -0	+2, -0	F	-	c, g

14 DOUBLE-V-GROOVE CJP WELD DETAIL

FOR BUTT JOINT(B)



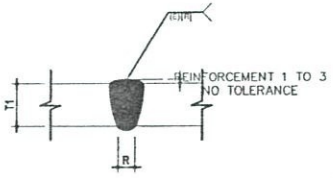
For B-U3c-S only	
T1	S1
Over To	
50 60	35
60 80	45
80 90	55
90 100	60
100 120	70
120 140	80
140 160	95
For T1 > 160 or T1 ≤ 50	
S1=2/3(T1-6)	

* NOTE
1. ALL DIMENSIONS IN mm
2. SEE 6 FOR WELDED LEGEND
3. √ : REQUIRE, X : NOT REQUIRE

WELDING PROCESS	JOINT DESIGNATION	BASE METAL THICKNESS (U=UNLIMITED)		GROOVE PREPARATION			PERMITTED WELDING POSITIONS	GAS SHIELDING FOR FCAW	WELDED NOTE
				ROOT OPENING ROOT FACE GROOVE ANGLE	TOLERANCE AS DETAILED	TOLERANCE AS FIT-UP			
		T1	T2						
SMAW	B-U3c	U	-	R=0 TO 3 h=0 TO 3 a=60°, b=60°	+2, -0 +2, -0 +10°, -0°	+2, -3 NOT LIMITED +10°, -5°	ALL	-	d, e, h, j
GMAW,FCAW	B-U3-GF						ALL	X	a, d, h, j
SAW	B-U3c-S	U	-	R=0 h=6 MIN a=60°, b=60°	+2, -0 +6, -0 +10°, -0°	+6, -0 NOT LIMITED +10°, -5°	F	-	d, h, j
				To find S1 see table above. S2=T1-(S1+6)					

15 SQUARE-GROOVE PJP WELD DETAIL

FOR BUTT JOINT(B)

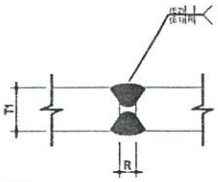


* NOTE
1. ALL DIMENSIONS IN mm
2. SEE 6 FOR WELDED LEGEND
3. √ : REQUIRE, X : NOT REQUIRE

WELDING PROCESS	JOINT DESIGNATION	BASE METAL THICKNESS (U=UNLIMITED)		GROOVE PREPARATION			PERMITTED WELDING POSITIONS	WELD SIZE (E)	WELDED NOTE
				ROOT OPENING	TOLERANCE AS DETAILED	TOLERANCE AS FIT-UP			
		T1	T2						
SMAW	B-P1a	3 max	-	R=0 TO 2	+2, -0	+2, -2	ALL	T1-1	b, e
	B-P1b	6 max	-	R=T1/2 min	+2, -0	+2, -2	ALL	T1/2	b, e
	B-P1c	U	-	R=T1/2 min	+2, -0	+2, -2	ALL	T1/2	b, e

16 SQUARE-GROOVE PJP WELD DETAIL

FOR BUTT JOINT(B)



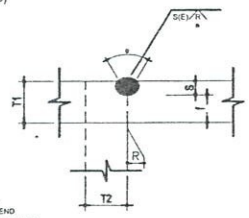
1. E1 + E2 MUST NOT EXCEED 3T1 / 4

* NOTE
1. ALL DIMENSIONS IN mm
2. SEE 6 FOR WELDED LEGEND
3. √ : REQUIRE, X : NOT REQUIRE

WELDING PROCESS	JOINT DESIGNATION	BASE METAL THICKNESS (U=UNLIMITED)		GROOVE PREPARATION			PERMITTED WELDING POSITIONS	TOTAL WELD SIZE (E1+E2)	WELDED NOTE
				ROOT OPENING	TOLERANCE AS DETAILED	TOLERANCE AS FIT-UP			
		T1	T2						
SMAW	B-P1b	6 max	-	R = T1 / 2	+2, -0	+2, -2	ALL	3T1 / 4	e

17 SINGLE-V-GROOVE PJP WELD DETAIL

FOR BUTT JOINT(B)

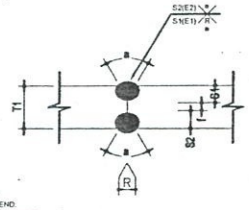


* NOTE
1. ALL DIMENSIONS IN mm
2. SEE 6 FOR WELDED LEGEND
3. √ : REQUIRE, X : NOT REQUIRE

WELDING PROCESS	JOINT DESIGNATION	BASE METAL THICKNESS (U=UNLIMITED)		GROOVE PREPARATION			PERMITTED WELDING POSITIONS	WELD SIZE (E)	WELDED NOTE
				ROOT OPENING ROOT FACE GROOVE ANGLE	TOLERANCE AS DETAILED	TOLERANCE AS FIT-UP			
		T1	T2						
SMAW	BC-P2	6 min	U	R=0 h= 1 mm a=60°	+2, -0 +U, -0 +10°, -0°	+3, -2 +2, -2 +10°, -5°	ALL	S	b, e, f, j
GMAW,FCAW	BC-P2-GF	6 min	U	R=0 h= 3 mm a=60°	+2, -0 +U, -0 +10°, -0°	+3, -2 +2, -2 +10°, -5°	ALL	S	a, b, f, j
SAW	BC-P2-S	11 min	U	R=0 h= 6 min a=60°	+0, -0 +U, -0 +10°, -0°	+2, -0 +2, -2 +10°, -5°	F	S	b, f, j

18 DOUBLE-V-GROOVE PJP WELD DETAIL

FOR BUTT JOINT(B)



* NOTE
1. ALL DIMENSIONS IN mm
2. SEE 6 FOR WELDED LEGEND
3. √ : REQUIRE, X : NOT REQUIRE

WELDING PROCESS	JOINT DESIGNATION	BASE METAL THICKNESS (U=UNLIMITED)		GROOVE PREPARATION			PERMITTED WELDING POSITIONS	TOTAL WELD SIZE (E1+E2)	WELDED NOTE
				ROOT OPENING ROOT FACE GROOVE ANGLE	TOLERANCE AS DETAILED	TOLERANCE AS FIT-UP			
		T1	T2						
SMAW	B-P3	12 min	-	R=0 h= 3 mm a=60°	+2, -0 +U, -0 +10°, -0°	+3, -2 +2, -2 +10°, -5°	ALL	S1 + S2	e, f, j
GMAW,FCAW	B-P3-GF	12 min	-	R=0 h= 3 mm a=60°	+2, -0 +U, -0 +10°, -0°	+3, -2 +2, -2 +10°, -5°	ALL	S1 + S2	a, f, j
SAW	B-P3-S	20 min •	-	R=0 h= 6 mm a=60°	+0, -0 +U, -0 +10°, -0°	+2, -0 +2, -2 +10°, -5°	F	S1 + S2	f, j

Revision (2013.09.10)

CONSTRUCTION DRAWING

GENERAL NOTES
STEEL STRUCTURE-3