Marin Bieloev

Design, Production and Assembly of Large-Sized Structural Elements of Large Diameter Reservoir Roofs

Abstract: The innovative method of constructing large-sized roofs (41 m in diameter) of oil reservoirs. The sizes of the individual sections of the umbrella-type roof structure were reduced by dividing them into two parts. As a result it was possible to increase the scope of shop production and facilitate transport and assembly, thus reducing total costs. Figures present joints made using shielded metal arc welding and self-shielded tubular-cored arc welding.

Keywords: large-sized roofs construction, oil reservoirs

CERTIFICAT DE RECEPTION 3.2 / EN 10204:2004

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ArcelorMittal

Client - Purchaser - Besteller: DELTA INTEGRA TRADING LLC

Référence client - Purchase order - Kaufauftrag: PO-OIT-T043-001-INDUSTEEL/

Projet - Project - Projekt: WEST QURNA- OILFIELD Repère poste - - 11

Industeel Belgium

Site : Rue de Châtelet 266 6030 Marchienne-au-Pont

ISO 9001 (Cert.91587-2011, Valid 02/06/2014) + MAQ REV 12 du 02/05/2012

ISO 9001 (Cert.91587-2011, Valid 02/06/2014) + QAM REV 12 of 02/05/2012

Produit - Product - Erzeugnis: Plate(s)

Commande / Poste - Internal order - Werkherstellung: 1054901 / 000240

Bordereau de livraison - Delivery note - Lieferungsdokument: 80238733 80238728 80238607

#020 - ANALYSE CHIMIQUE DE COULEE - LADLE CHEMICAL COMPOSITION - SCHMELZE CHEMISCHE ZUSAMMENSETZUNG

	C	Mn	P	S	Si	Cu	Ni	Cr	Mo
	%	%	%	%	%	%	%	%	%
Min.									
31533	0.126	0.893	0.0084	0.0019	0.163	0.131	0.106	0.138	0.028
Max.	0.240	0.900	0.0350	0.0400	0.400				

	Al	Nb	V	(01)
	%	%	%	
Min.				
31533	0.039	0.001	0.001	0.324
Max.				0.430

(01) Ceq = C+(Mn/6)+((Cu+Ni)/15)+((Cr+Mo+V)/5)

#030 - ANALYSES PRODUITS - PRODUCTS ANALYSIS - STÜCKANALYSEN

	C	Mn	P	S	Si	Cu	Ni	Cr	Mo
	%	%	%	%	%	%	%	%	%
Min.									
430543.5001	0.124	0.867	0.0089	0.0017	0.177	0.131	0.106	0.138	0.028
430552.5001	0.126	0.864	0.0075	0.0017	0.191	0.131	0.106	0.138	0.028
430553.5001	0.126	0.867	0.0089	0.0021	0.181	0.131	0.106	0.138	0.028
Max.	0.240	0.900	0.0350	0.0400	0.400				

	Al	Nb	V	(01)
	%	%	%	
Min.				
430543.5001	0.039	0.001	0.001	0.318
430552.5001	0.039	0.001	0.001	0.319
430553.5001	0.039	0.001	0.001	0.319
Max.				0.430

(01) Ceq = C+(Mn/6)+((Cu+Ni)/15)+((Cr+Mo+V)/5)

Nous certifions que les produits ci-dessus sont conformes aux prescriptions de la commande.

We hereby certify that the above mentioned products are complying with the order requirements.

Wir bestätigen hiermit, dass die obengenannten Erzeugnisse den Bestellungsvorschriften entsprechen.

BUREAU VERITAS INSPECTION STANDARD INDUSTRY & FACILITIES

STEPHANIE WALLEMACQ 07/01/2013

Quality certificate of ordered plates – chemical composition

The Consortium KZU Holding Group is comprised of companies predominantly specialising in the production of large-sized reservoirs for oil and its derivatives. The companies have a record and experience of constructing such vessels in Bulgaria, Germany, the Czech Republic, Morocco, Sudan, Jordan and, recently, Iraq.

Obtained references enabled undertaking the construction of several reservoirs 3×5000 m^3 in South Iraq – object West Qurna 1. The vessels are intended for storing crude oil mixed with water, which is further separated in a separator. The end-user of the products stored in the object is EXXONMOBIL, Houston, USA. The product stored in the vessel contains significant amounts of hydrogen sulphide (H_2S), which affects the corrosion resistance

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of the structure and is decisive for the selection of steel grade.

As can be seen, the batches of plates received are characterised by low phosphorus and sulphur contents. At the reservoir design stage it was necessary to take into account the intended use and conditions of the vessels hence their relatively small height. The height, H, amounts to 6 m, yet the diameter of reservoirs is significant and the roof is a self-supporting umbrella structure. The design was conducted in accordance with API 650.

Due to its size, the roof consists of many elements and is difficult to make and assemble on the object. In order to reduce labour consumption, design works focused on maximising the sizes of components made at the manufacturer's plant and transporting them on a lorry platform taking into account the greater size and assembly of such components at the target object location.

Maximisation of Component Sizes at the Manufacturer

The roof supporting structure was composed of

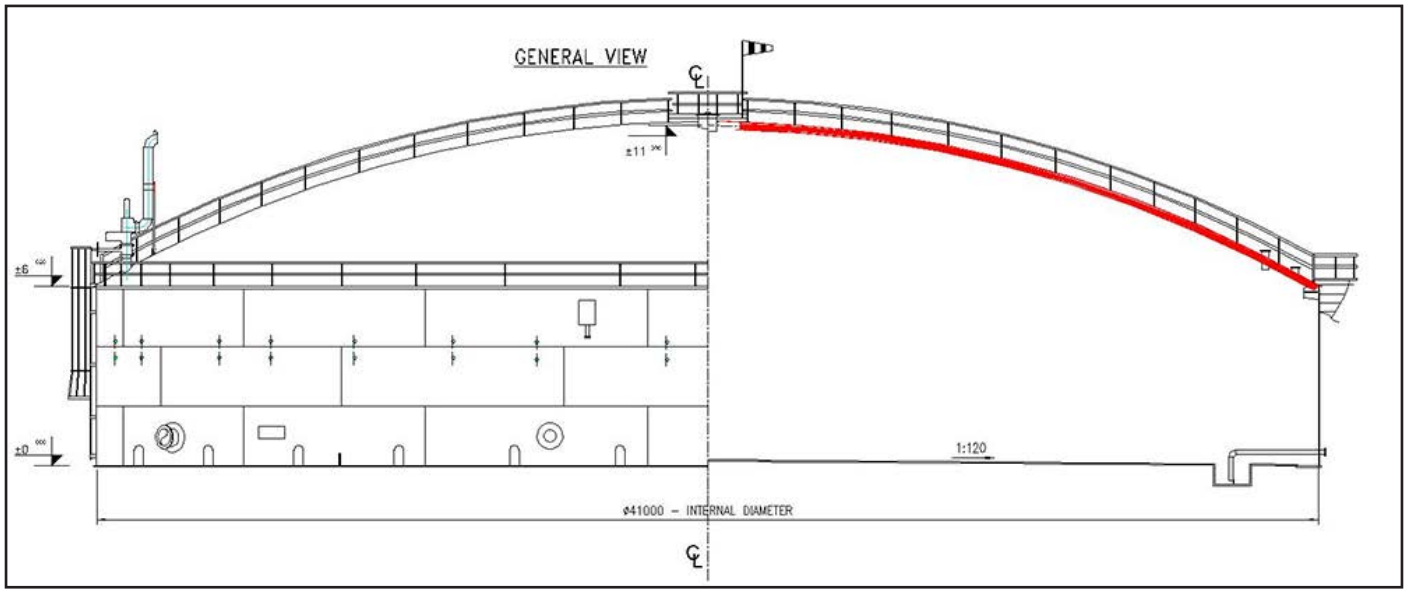

Fig. 1. Reservoir main view. Diameter 41000 mm; Wall height 6000 mm

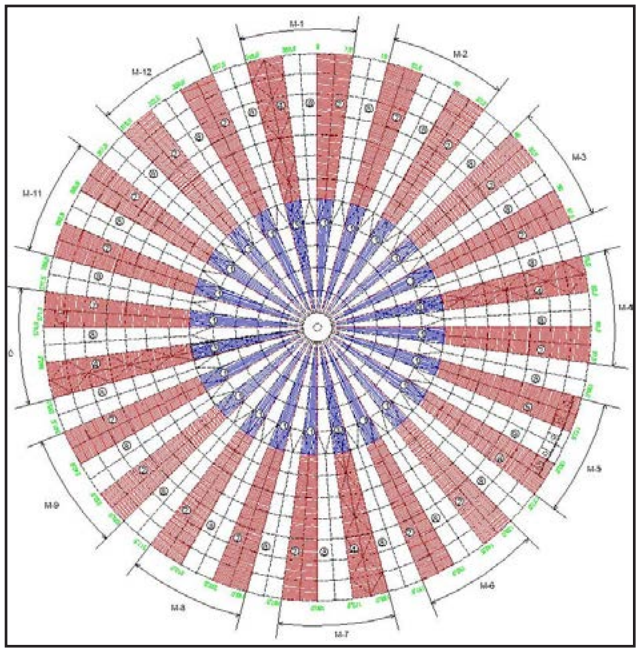

Fig. 2. Reservoir roof main view; ø 41000 mm

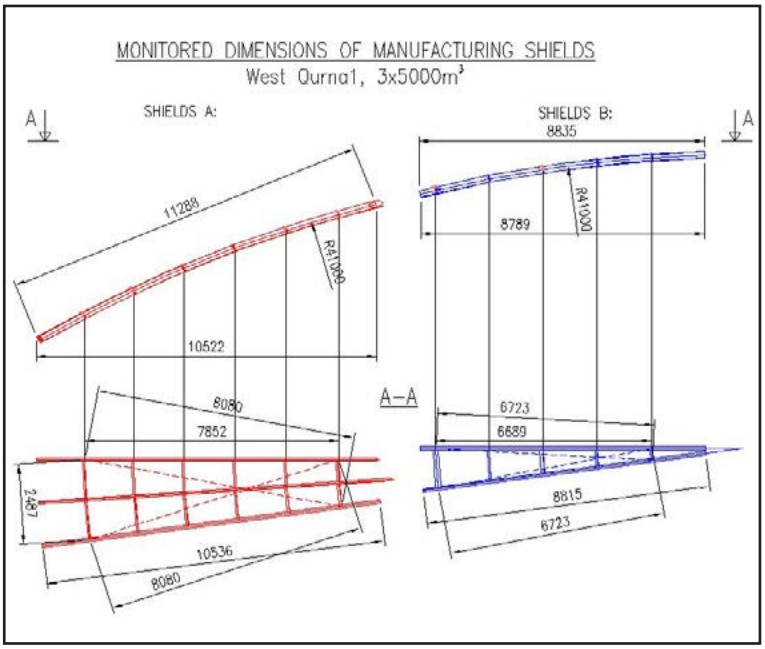

Fig. 3. Size increase at the manufacturer

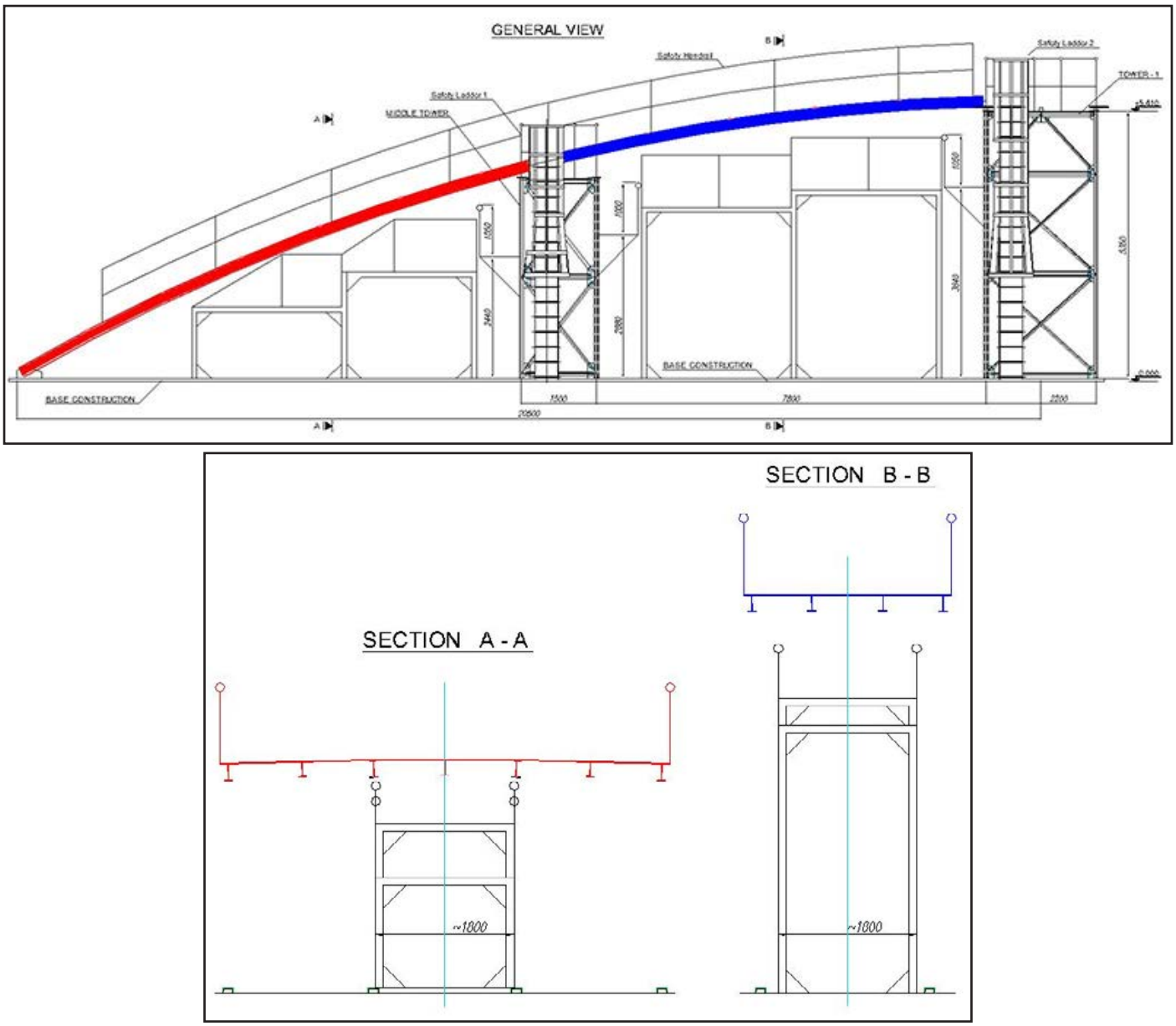

Fig. 4. Stand for size increase on pre-assembly site

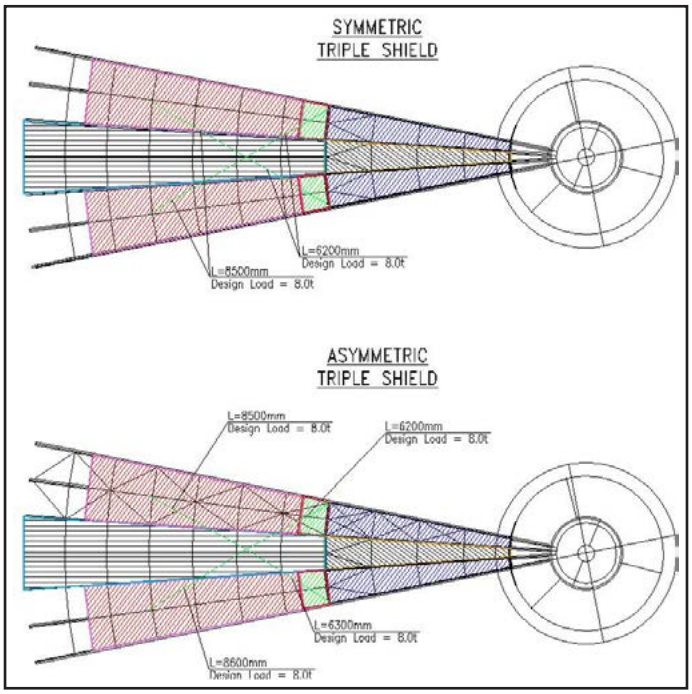

Fig. 5. Increased size assembly shields

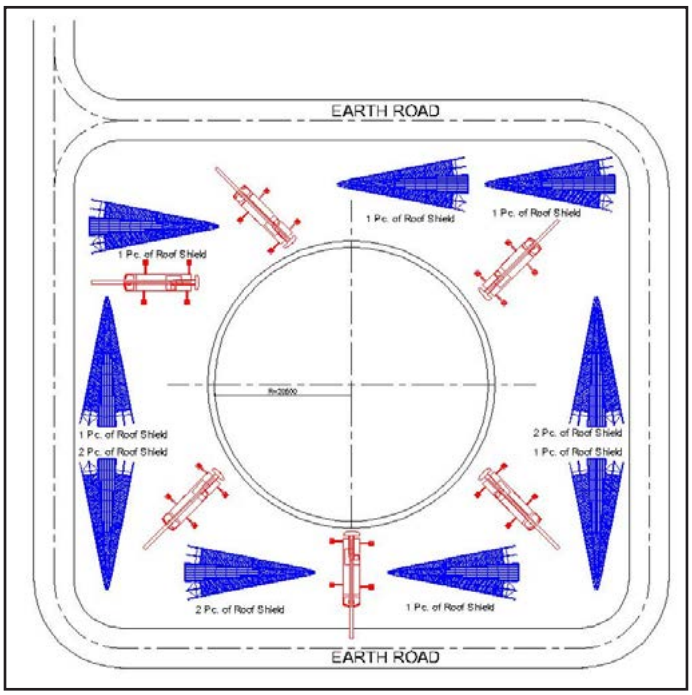

Fig. 6. Assembly of increased size shield pieces

48 basic radial beams made of IPN 220 shapes, short intermediate beams made of IPN 200 shapes and steel plating. The size increase consisted in connecting two shields (big and small) which could be transported. On one lorry platform it was possible to transport 8 large or 16 small shields weighing 23 tons in total.

Size Increase on Pre-assembly Site

On the pre-assembly site, large and small shields as well as loose components were pieced together on a special assembly stand.

Shields from M1 to M12 ready for assembly placed around the foundation in accordance with Figure 2.

Welding Technologies Used On Assembly Site

1. On the cross-sections A–A and B–B, Figure 9 presents the joints of roof plate fixing elements made on the site using the assembly stand. It was assumed that method 111, i.e. shielded metal arc welding or method 114, i.e. self-shielded tubular-cored arc welding would be used.
2. Welding method 111 was used in order to improve welder's ease in various positions, during assembly and in intersection spaces.

As mentioned above, larger sized shields were placed around the foundation and their assembly was carried out on the opposite sides

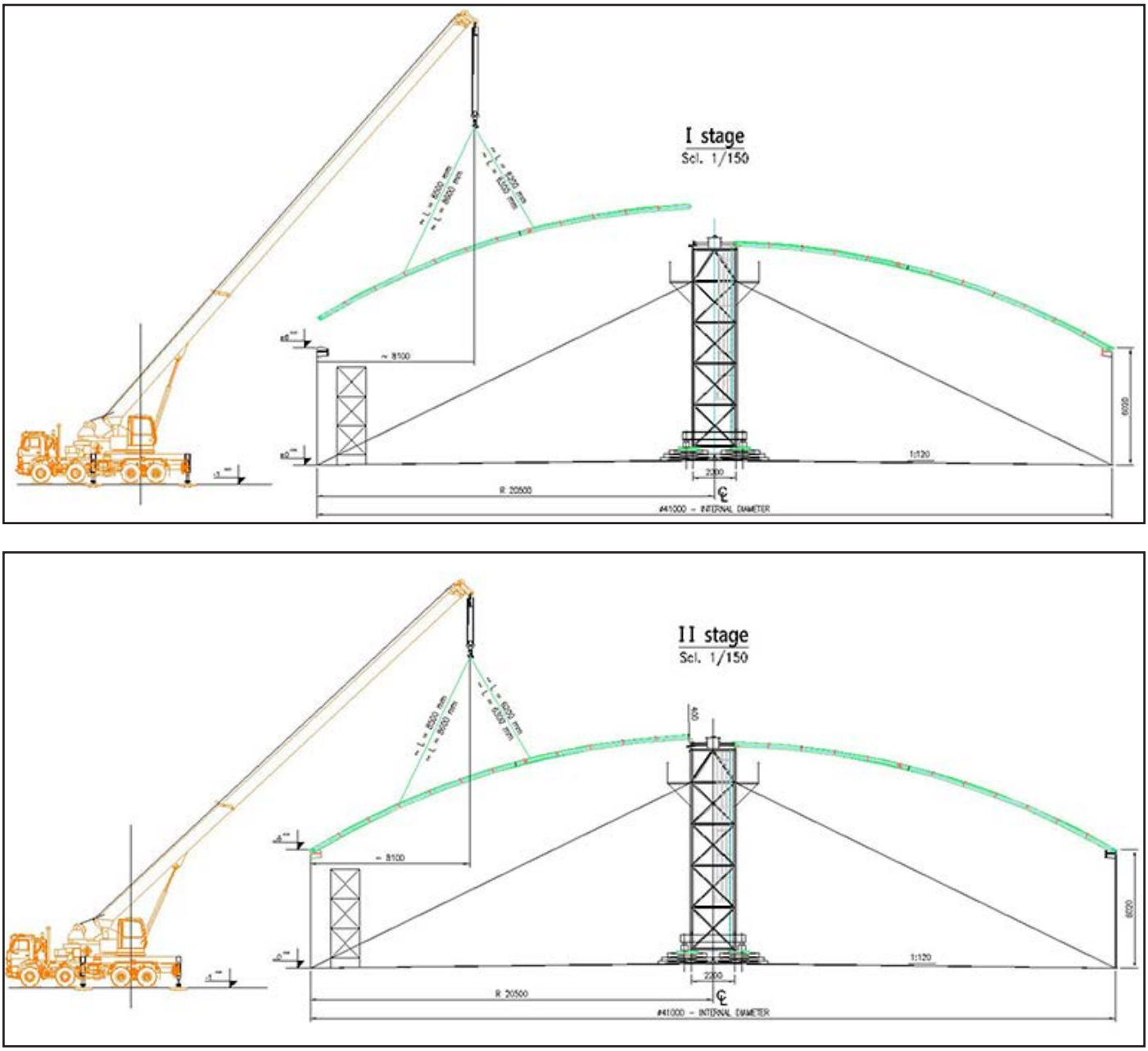

Fig. 7 and 8. From M1 to M-12

using a travelling crane. After the assembly the shields were joined, which was the last operation connected with the roof construction.

As can be seen in the presented scheme, 75% of the roof structure was made in the plant and the element sizes were enlarged on the pre-assembly site providing welders with convenient welding positions. In consequence, it was possible to reduce assembly time and number of necessary personnel, which translated to lower costs.

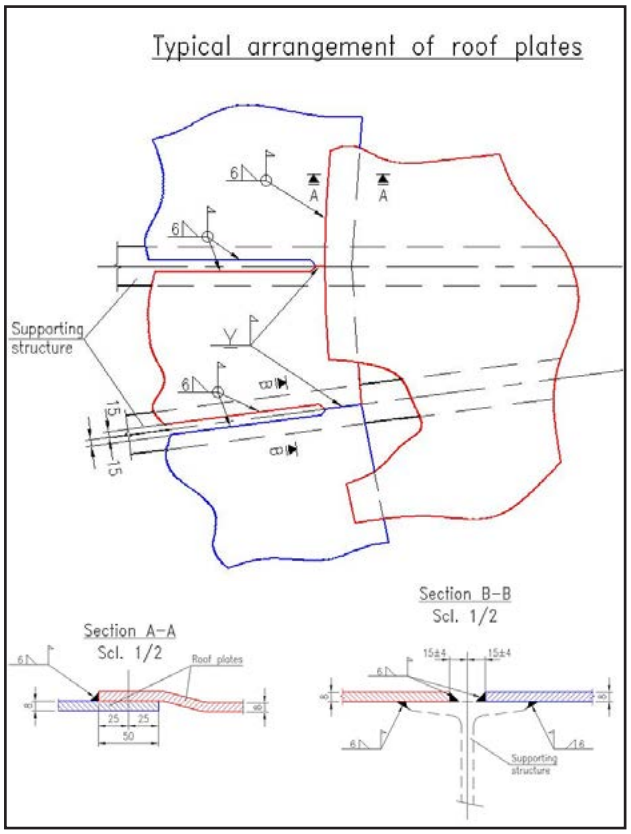

Fig. 9. Welded joints

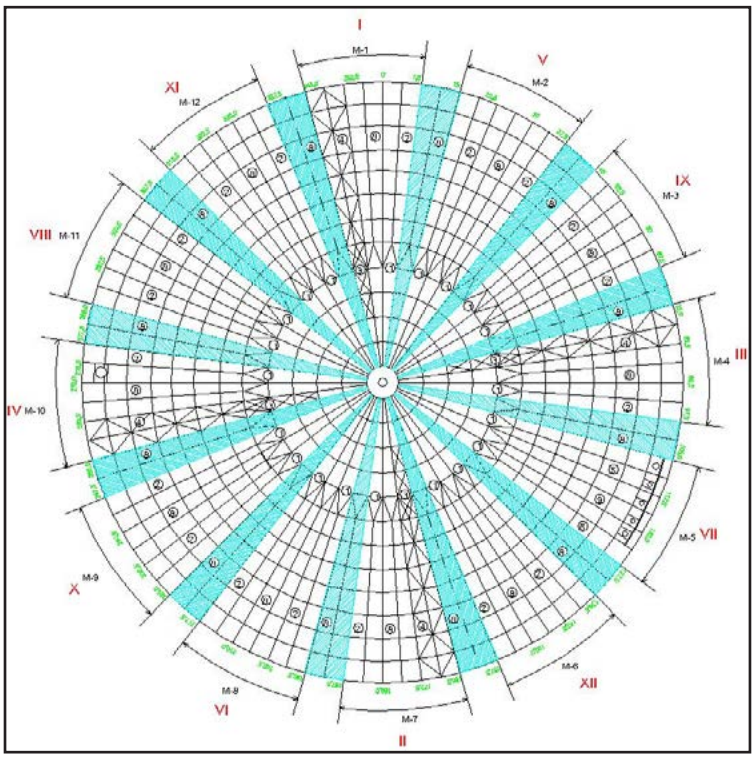

Fig. 10. Roof assembly system