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## Technical Information on ISO Shipping Container

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# Technical Information on ISO Shipping Container

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**Abstract.** Shipping container had become popular among construction industry as alternative building material. However, the information on the shipping container detailing had been lacking and not easily accessible by designer. This paper summarised the technical information of ISO shipping container including geometry properties, materials and structural testing. The information was presented in tables which are easier to interpret and use in structural design.

## 1. Introduction

ISO shipping container, been standardized steel box to be purposed for universal cargo transportation, is one of the potential candidates to solve the housing problem. The shipping container is designed to withstand harsh weathering and heavy loading over long distance transportation. This makes it very durable and suitable for housing purpose. As the matter of fact, modified shipping container had been used in construction industry for decades and being popularized among architect and engineers in recent years [1-3].

ISO shipping container is built to the specification stated by International Standard Organization (ISO) and International Convention for Safe Containers (CSC). However, the shipping container is built up by section much differ from conventional steel section. Although some of the data can be found from ISO documentation, as engineer it is more convenient to get the information in intuitive representation instead of lengthy description.

This paper had summarised the technical information of ISO shipping container required for engineering practice. The information gathered will be presented in table format to ease the intended user in data collection

## 2. Data Source

The ISO shipping container chosen for this work is 20 feet ISO-1CC type steel dry cargo container manufactured by Singamas Management Services Limited [4]. All the data collected is either provided by manufacturer or is stated in ISO documentation. Some of the related ISO documents published by British Standard Institution (BSI) are listed as below:

- i. BS ISO 668:1995 [5] – classification, dimensions and ratings for series 1 freight containers.
- ii. BS ISO 1496-1:1990 [6] – specification and testing for freight containers.
- iii. BS ISO 1161:1984 [7]– specification for corner fittings for series 1 freight container.
- iv. BS ISO 3874:1997 [8] – handling and securing freight containers.



### 3. ISO Shipping Container Dimension and Rating

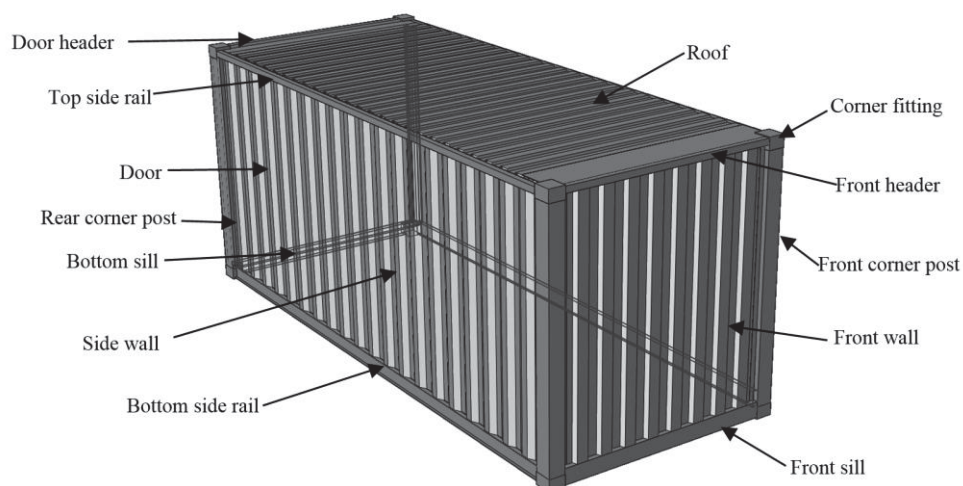
Typically, ISO shipping containers has standard height  $\times$  width = 2.591 m  $\times$  2.438 m, and two common lengths of 6.058m (referred to “20-ft container”) and 12.192 m (referred to “40-ft container”). Some special 40-ft container might have the height of 2.896 m (9-ft), which is called High Cube container. Each of these containers should have maximum gross mass of 30480kg. Table 1 showed the details in dimension for each container types. For instance, ISO designation with letter ‘A’ indicates 40 ft container whereas letter ‘C’ indicates 20 ft container.

**Table 1.** ISO Shipping Container Dimension and Rating [5]

ISO Designation	Common Name	External dimension (mm)			Internal dimension (mm)			Rating (kg)
		Length	Width	Height	Length	Width	Height	
1EEE	45' high cube	13716	2438	2896	13542	2330	2655	30480
1EE	45' standard			2591			2350	
1AAA	40' high cube	12192		2896	11998		2655	30480
1AA	40' standard			2591			2350	
1A	40'			2438			2197	
1BBB	30' high cube	9125		2896	8931		2655	30480
1BB	30' standard			2591			2350	
1B	30'			2438			2197	
1CC	20' standard	6058		2591	5867		2350	30480
1C	20'			2438			2197	
1D	10'	2991		2438	2802		2197	10160

### 4. ISO Shipping Container Components

ISO shipping container is assembled from many components to be welded into an integrated structure. Figure 1 showed the ISO container assembly and Table 2 depicted the detailed information of each structural component of ISO container.



**Figure 1.** An ISO shipping container shown with front assembly.

Table 2. ISO Shipping Container Components [4,9]

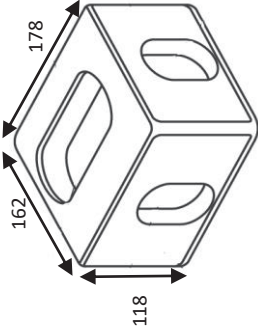
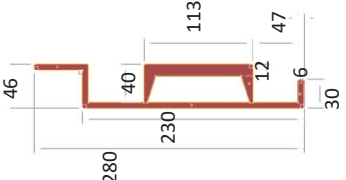
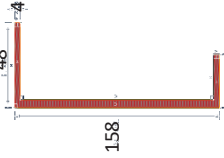
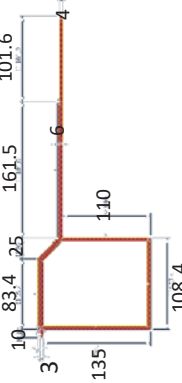
Parts	Dimensions	Material Selection	Parts	Dimensions	Material Selection
Corner fitting		Casted Weldable Steel SCW 49 (ASTM A216) Yield strength, $f_y$ (MPa)= 274.58 Ultimate strength, $f_u$ (MPa)= 480.53 Elongation (%) = 20	Rear corner post	Height: 2355mm 	Outer: Weathering Steel CORTEN-A (ASTM A242) Yield strength, $f_y$ (MPa)= 343.23 Ultimate strength, $f_u$ (MPa)= 480.53 Elongation (%) = 22 Inner: Hot Rolled Hi-Tensile Shaped Steel SM50YA (A1011) Yield strength, $f_y$ (MPa)= 362.85 Ultimate strength, $f_u$ (MPa)= 490.33 Elongation (%) = 15
Bottom side rail	Length: 5702mm 	Weathering Steel CORTEN-A (ASTM A242) Yield strength, $f_y$ (MPa)= 343.23 Ultimate strength, $f_u$ (MPa)= 480.53 Elongation (%) = 22	Door header	Length: 2340mm 	Weathering Steel CORTEN-A (ASTM A242) Yield strength, $f_y$ (MPa)= 343.23 Ultimate strength, $f_u$ (MPa)= 480.53 Elongation (%) = 22

Table 2. ISO Shipping Container Components [4,9]

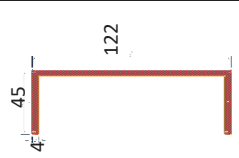
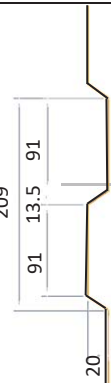
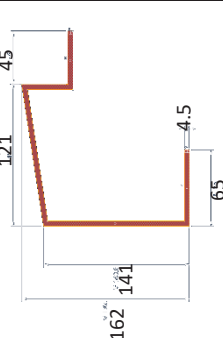
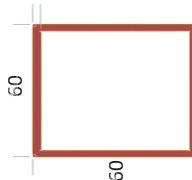
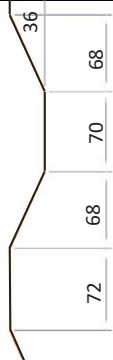
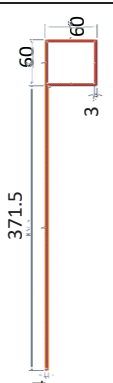
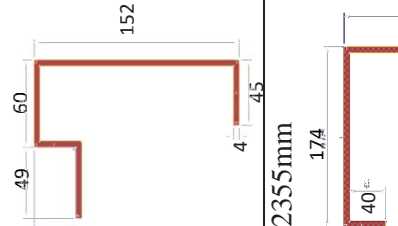
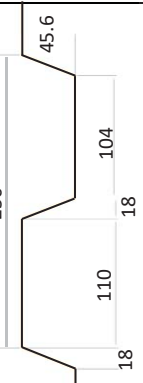
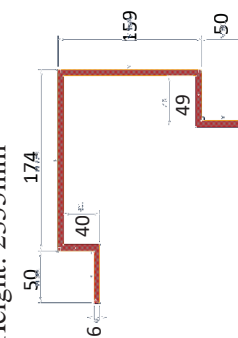
Parts	Dimensions	Material Selection	Parts	Dimensions	Material Selection
Cross member	Length: 2336mm 	Weathering Steel CORTEN-A (ASTM A242) Yield strength, $f_y$ (MPa)= 343.23 Ultimate strength, $f_u$ (MPa)= 480.53 Elongation (%) = 22	Roof	5225(Length) x 2356 (Width) x 2mm (Thickness) 	Weathering Steel CORTEN-A (ASTM A242) Yield strength, $f_y$ (MPa)= 343.23 Ultimate strength, $f_u$ (MPa)= 480.53 Elongation (%) = 22
Door sill	Length: 2340mm 	Weathering Steel CORTEN-A (ASTM A242) Yield strength, $f_y$ (MPa)= 343.23 Ultimate strength, $f_u$ (MPa)= 480.53 Elongation (%) = 22	Top side rail	Length: 2114mm 	Weathering Steel CORTEN-A (ASTM A242) Yield strength, $f_y$ (MPa)= 343.23 Ultimate strength, $f_u$ (MPa)= 480.53 Elongation (%) = 22
Side wall	5580(Length) x 2329(Height) x 2mm (Thickness) 	Weathering Steel CORTEN-A (ASTM A242) Yield strength, $f_y$ (MPa)= 343.23 Ultimate strength, $f_u$ (MPa)= 480.53 Elongation (%) = 22	Front Header	Length: 2313mm 	Weathering Steel CORTEN-A (ASTM A242) Yield strength, $f_y$ (MPa)= 343.23 Ultimate strength, $f_u$ (MPa)= 480.53 Elongation (%) = 22

Table 2. ISO Shipping Container Components [4,9]

Parts	Dimensions	Material Selection	Parts	Dimensions	Material Selection
Front Sill	Length: 2114mm 	Weathering Steel CORTEN-A (ASTM A242) Yield strength, $f_y$ (MPa)= 343.23 Ultimate strength, $f_u$ (MPa)= 480.53 Elongation (%) = 22	Front wall	2114(Width) x 2351(Height) x 2mm (Thickness) 	Weathering Steel CORTEN-A (ASTM A242) Yield strength, $f_y$ (MPa)= 343.23 Ultimate strength, $f_u$ (MPa)= 480.53 Elongation (%) = 22
Front corner post	Height: 2355mm 	Weathering Steel CORTEN-A (ASTM A242) Yield strength, $f_y$ (MPa)= 343.23 Ultimate strength, $f_u$ (MPa)= 480.53 Elongation (%) = 22	Door	2340(Width) x 2280(Height) x 2mm(Thickness)	Weathering Steel CORTEN-A (ASTM A242) Yield strength, $f_y$ (MPa)= 343.23 Ultimate strength, $f_u$ (MPa)= 480.53 Elongation (%) = 22

## 5. ISO Shipping Container Materials

It can be seen from Table 2 that most parts of ISO shipping container are built with CORTEN steel, a type of weathering steel with chemical composition that enabled it to develop rust protective layer against atmospheric corrosion. Table 3 shows the material properties of CORTEN-A steel compared to other steel types.

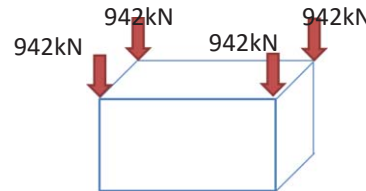
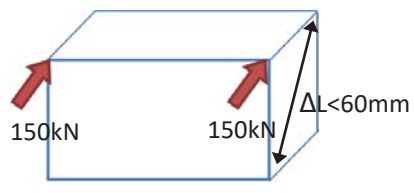
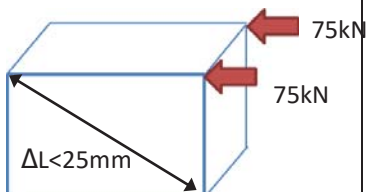
**Table 3.** Material properties for CORTEN-A [10] in comparison with S275 and S355 Steel [11]

Brand	Thickness (mm)	Mechanical Properties			Chemical Composition (%)					
		$F_y$ (N/mm <sup>2</sup> )	$F_u$ (N/mm <sup>2</sup> )	Elongation (%)	C	Si	Mn	P	S	Cu
ASTM A242 CORTEN A	≤ 20	343	480	22	≤0.15	N.A.	≤1.00	≤0.15	≤0.05	≤0.20
EN S235	≤ 16.0	235	360-510	19	0.16	0.45	0.70	0.04	0.04	0.20
EN S355	≤ 16.0	355	470-630	16	0.19	0.55	1.60	0.04	0.04	0.20

## 6. Standard Load Test for ISO Shipping Container

ISO 1496 had described the structural testing for ISO freight container. The standard depicts on the testing items, loading, and criteria to pass the test including deflection under loading and residual deformation. For instance, stacking strength, transverse rigidity and longitudinal rigidity are the most crucial for overall structural integrity and the testing details are summarized in Table 4.

**Table 4.** Standard Testing Requirement for ISO Shipping Container [4,6]

Testing	Loading	Permissible Criteria	
		Deflection under load	Residual Deformation
Staking		Corner Post: 4mm Bottom Side Rail: 4mm Cross Member: 6mm	Corner Post: 2mm Cross Member: 3mm
Rigidity (Transverse)		End Frame: 60mm	End Frame: 10mm
Rigidity (Longitudinal)		Side Frame: 25mm	Side Frame: 7mm

## 7. Conclusion

Reuse of ISO shipping container in construction industry can be innovative and promote sustainable environment. The provision of ISO container information in intuitive manner can be convenient for engineers for their design purpose. Such informative data will help to promote container building and thus bring new life to the abandoned shipping container.

## Acknowledgments

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