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Architect: Santiago Calatrava
Location: Malmo, Sweden
Design: 1999-2001
Construction: 2001-2005
Type: Residential Tower
Structure: Core and Slabs (concrete)
Exoskeleton: Steel
Height: 623ft.
Levels: 56
Façade Area: 215,278ft.²
Net Floor Area: 227,710ft.²
Based on the sculpture, “Twisting Torso” exploring the human body in motion, twisting as far as it can naturally being pushed while staying directly upright.

Form is made up of 9 cubes, each individual cube containing five stories.
Twists 90 degrees from the ground level to the top floor
Each floor consists of a square section around the core and a triangular part supported by an external steel structure.

The central core is supported by a foundation slab.

The corner of each floor is a concrete column supported by a pile foundation.
The structural slab is fitted around the core.

The forms for the structural slab are triangular shapes, together forming a floor.

The forms were rotated 1.6 degrees for each floor in order to create the characteristic twist of the building.
The core is the main load-bearing structure

Large concrete pipe, with an inner diameter of 35ft.

The walls are 8ft. Thick at the bottom, gradually shifting to 1ft. thick at the top

The elevator shafts and staircases are located inside the core
The steel support is located on the exterior of the building, which is linked together by the spine, acting as the loading backbone from the winds.

The steel support transfers shear forces to the supporting concrete core.

Each steel section of the spine has to fit precisely in the one below it.
The system consists of a spine column at the corner of each floor plus horizontal and diagonal elements that reach to each side of the glazed spine.

Stabilizers also connect the floor slabs with the framework.
The tower rests on piles driven into a foundation of solid limestone bedrock at 49ft. below ground level

Avoids unacceptable bending or swaying
Steel Spine

Cantilever Floor Slab

Concrete Core

Foundation
Steel Spine

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The twisted form can be very effective, alleviating the effects of vortex-shedding induced by lateral wind loads and minimizing the wind loads from prevailing direction.
When analyzing the structure under wind loads, Calatrava found that the Turning Torso could move up to 3ft. at the top during the most severe storm.

Giant pins attached to the ground were then implemented, decreasing the movement to less than a foot during the most severe storm, which is nearly unnoticeable.
The building was constructed using an Automatic Climbing Structure

This four story workhouse climbs up the building as each floor is completed
First, it shapes the concrete core, then a large ground pump draws the concrete to fill the forms.

After the concrete is poured, the ACS climbs.
Next, table form sections are lifted up with a crane, and provide a place to set rebar. Concrete is again pumped up to form the floor slabs. Before the table slabs are moved to the next floor, they are removed and inspected on the ground.
Double curved glass and aluminum façade

2,800 curved panels and 2,250 flat windows in the façade

In order to follow the twist of the building, the windows are leaning between 0 and 7 degrees either inwards on the western façade or outwards on the eastern façade.
Turning Torso twists new life into cubism, Elias, Helen - *The Architects' Journal*; Sep 2, 2004; 220, 8; ProQuest


http://www.flickr.com/photos/dahlstroms/930478070/in/photostream/

http://www.hsb.se/malmo/turningtorso/in-english

http://rustamkhairi.fotopages.com/?&page=12

http://danmorrissey.wordpress.com/

http://www.scribd.com/doc/61614381/The-Shape-From-Behind-to-Beyond

http://www.e-architect.co.uk/sweden/turning_torso_malmo.htm

REFERENCES
Complicated glass and aluminum façade

Double curved to compensate for twisting building

2,800 curved panels and 2,250 flat windows in the facade.

In order to follow the twist of the building, the windows are leaning either inwards or outwards, depending on which side of the building they are on. On the western side they are leaning inwards and on the eastern, outwards. This leaning of the windows is between 0 and 7 degrees, while the lateral leaning is about 6 degrees.