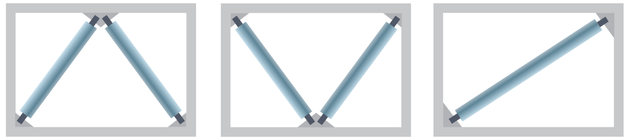
Feature of UBB™

Layout Image



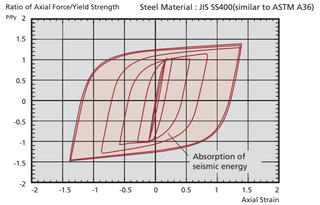
Chevron type　　V-shaped type　　Single type

Non-buckling and equivalent strength in tension and compression enables a variety of layout patterns.

UBB™ Performance

Hysteresis loops in tension and compression have equal strength and stiffness, in the pre- and post-yield ranges.

1) Same stiffness in tension and compression
2) Same strength in tension and compression
3) Stable and symmetric behavior in tension and compression



BCJ Approval*

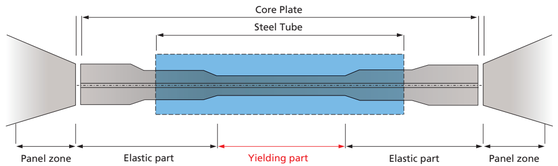
*License Number BCJ-ST0125-03 (effective to Oct.2015) & BCJ-ST0126-02 (effective to Oct.2015)

UBB received a "BA" classification approval from Building Center of Japan (BCJ) as both a seismic control member and a structural element, and as a result can be used to achieve designs that are more economical than regular structural systems.

Satisfaction of seismic manual issued by AISC

UBB™ has been conducted a number of loading tests which satisfy design requirement of seismic design manual issued by American Institute of Steel Construction (AISC).

Detail of UBB™



Yielding part absorbs energy from a severe earthquakes.

2006
Retrofit project in Tokyo Institute of Technology

2008
UBB application for bridge.

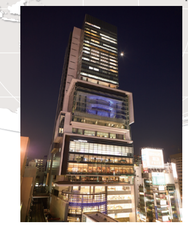
2011
1000t UBB performance test at National Center for Research on Earthquake Engineering

UBB™s are adopted more than 800 projects in the world.

China

The USA

Japan



Taiwan

Material Specifications

Core Plate	JIS SN400 [similar to ASTM A1043(Gr.36)] JIS SN490 [similar to ASTM A1043(Gr.50)] NSSMC Standard BT-LYP225(Certified material by Ministry of Land, Infrastructure, Transport and Tourism) ASTM A36 ASTM A1043 (Gr. 36) ASTM A1043 (Gr. 50) * Minimum core plate thickness is 12mm (1/2in.) [19mm (3/4in.) or thicker is recommended].
Steel Tube	ASTM A500, JIS STKR400 or JIS STK400, Thickness : 3.2 mm to 16 mm Width or Diameter : 100 to 500 mm (larger sizes are possible upon request)
Mortar	As per Technical specification
Design of Steel Tube	As per Technical specification

Contacts

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■ URL　http://www.eng.nssmc.com/english/

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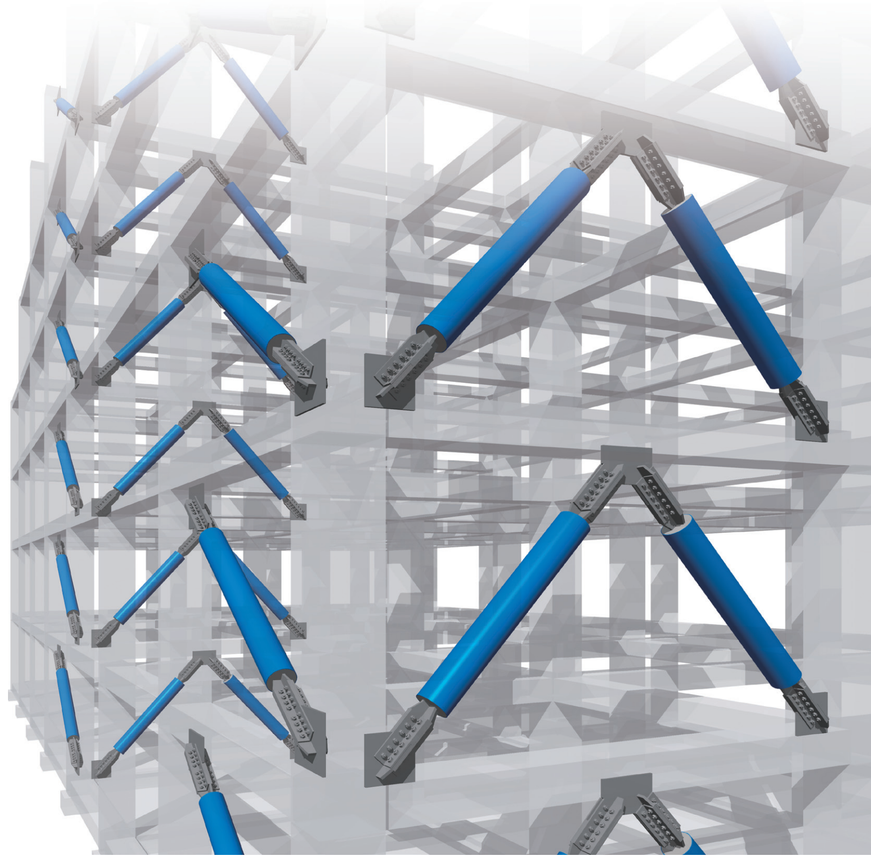
NSENGI

UBB™
(Unbonded Brace)

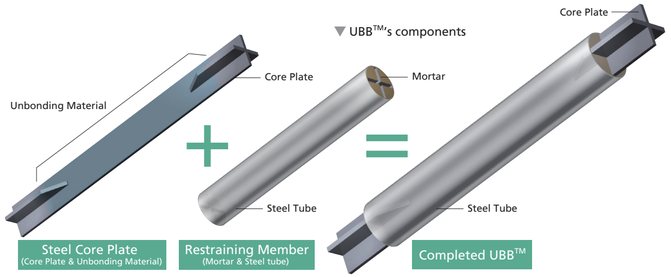


NIPPON STEEL & SUMIKIN ENGINEERING

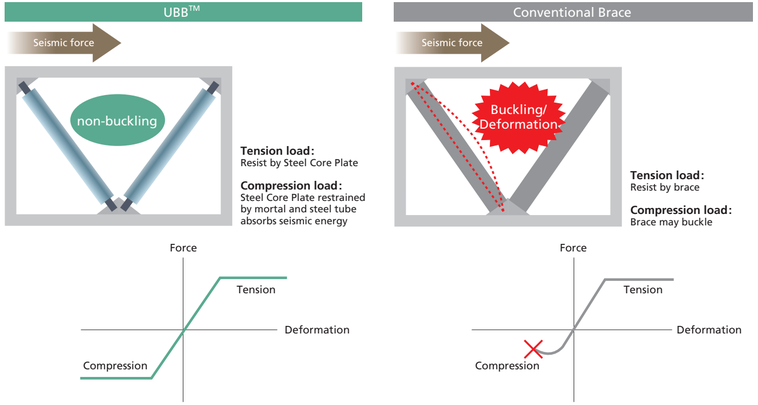
Most Widely Used BRB(Buckling Restrained Brace) in the World!!

UBB™'s Main Components

UBB™ is a structural brace element consisting of a steel core plate which is restrained by mortar and steel tube.
A membrane called the unbonding material, between the mortar and the core plate, ensures that axial forces in the core plate do not transfer to the mortar and the steel tube.
This ingenious combination of components produces stable and symmetric tension-compression hysteretic behavior.



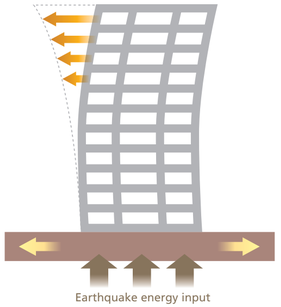
UBB™ Concept



What's Response Controlled Structure?

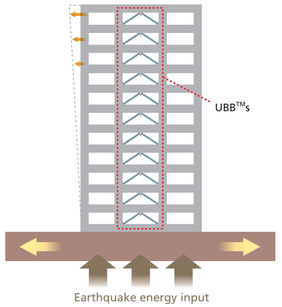
Conventional Structure

Primary frame itself has to resist seismic force



Response Controlled Structure with UBB™

Response control devices UBB™s absorb seismic force to minimize the damage and the horizontal deformation of structure



	Conventional Structure	Response Controlled Structure with UBB™
Features	Primary frame itself (columns and girders) resists an earthquake.	Structure with UBB™s as response control devices absorbs seismic energy.
Horizontal vibration during earthquake	△ Severe horizontal vibration.	○ Smaller horizontal vibration as UBB™s absorb seismic energy.
After a severe earthquake	△ Severe damages on primary structure that may occur make the building be unable to use continuously.	○ Less damage of primary frame because UBB™s absorb seismic energy.

UBB™ Configurations and Core Material Types

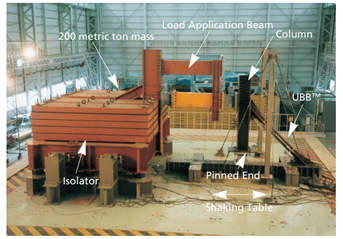
Type of Core Plate	Material Specification
Flat Plate (–)	●JIS SN400 [similar to ASTM A1043(Gr. 36)] ●JIS SN490 [similar to ASTM A1043(Gr. 50)] ●NSSMC Standard BT-LYP225 ●ASTM A36 ●ASTM A1043 (Gr. 36) ●ASTM A1043 (Gr. 50)
Cruciform (+)	

Performance Data

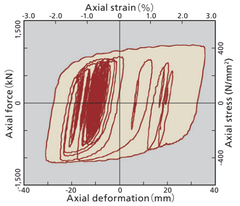
Full-Scale Dynamic Shaking Table Tests*

*Building Research Institute Laboratory, Tsukuba, Japan

The JMA Kobe Observatory ground motion (Kobe, 1995) was applied at maximum velocities from 10 to 70 cm/s (4 to 27.6 in/s), and the UBB™ showed stable hysteretic behavior for axial strains as high as 7.5%.
The El Centro ground motion (California, 1940) was applied at maximum velocities from 5 to 90 cm/s (2 to 35.4 in/s) and the UBB™ showed stable hysteretic behavior for axial strains as high as 7.2%.

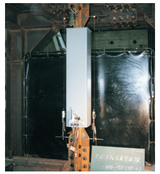


▼Typical Result, Full-Scale Shaking Table Test

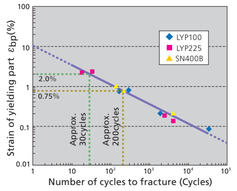


Fatigue Resistance

Under low-cycle fatigue testing, UBB™s show stable hysteretic behavior for over 100 cycles at an axial strain of ± 1%.



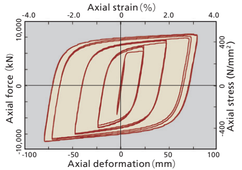
Fatigue Test



Subassembly Tests

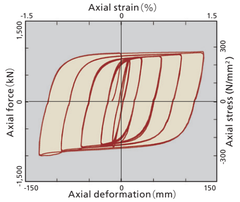
Subassembly tests for UBB™s have been performed in the USA and Japan within the range between 450kN (100kips) and 6000kN (1350kips).

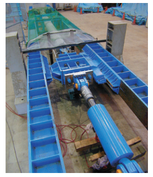
Building Research Institute Laboratory, Tsukuba, Japan



Tests for Pin-End Type

Tests of UBB™s with pinned connections have been performed in the USA and Japan for braces up to 14.0m (45.9ft) in length.





Engineering R&D Institute #1,Futtsu, Japan

History of UBB™

Early 1980s
Original research and development of BRBs by Nippon Steel Corporation 1987

1987
UBB applications have started in Japan.

1997
Exposed and Circular Tube UBB comprising Buttress Structure
Nihon TV Tower, Tokyo

1998
Very Large UBB (22m, 72.5ft long)
Osaka International Convention Center

1999
First BRB/UBB project in the USA
The new Plant & Environmental Sciences Building at U, C Davis

2000
Exposed Braces with Cast End Connections
Toyota Stadium, Aichi

2001
First BRB/UBB project in Taiwan
Taipei County Government Building

2005
UBB performance test at UCSD.
UCSD: University of California San Diego

2005
First BRB/UBB project in China
Tsinghua Science Park Building, Beijing