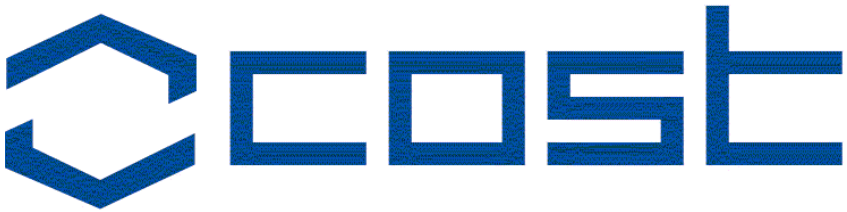


**COST C26: Urban Habitat Constructions under Catastrophic Events**
**Praha, March 30-31, 2007**

# High strength steel for seismic resistant building frames


**Dan Dubina, R. Zaharia & D. Grecea**
**Politehnica University of Timisoara**

**F. Dinu, V. Ungureanu**
**Romanian Academy, Timisoara**


# Introduction

- High strength steels HSS with yield stress of 420-690 MPa or greater have been available for many years.
- There are many applications of HSS in bridge construction,
- In Europe, steel grades S460-S690 are considered "new materials" for seismic applications.
- In US and Japan HSS - more applications. Structural configurations using HSS:
  - Dual frame configurations – MR frames + braced frames with dissipative braces or low-yield dissipative panels - for high-rise buildings
  - MR frames with composite steel (HSS) - concrete columns, partially encased, with controlled dissipation in beams with reduced section (dog-bone) and/or column panel zones, for buildings of intermediate height

# HSS applications to buildings in seismic areas

- In seismic areas, the building design is usually controlled by specific design requirements (proper criteria for strength, stiffness and ductility)
- Steel building frames are designed as dissipative structures and plastic deformations are allowed to develop in specific members
- The members designed to remain in elastic range during the earthquake, as the columns in multi-storey frames, are usually characterized by high demands in strength.
- For such kind of members the use of HSS represents a real and effective opportunity.
- Ongoing projects

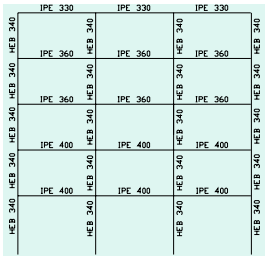
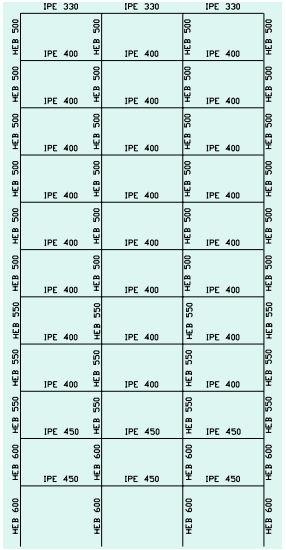
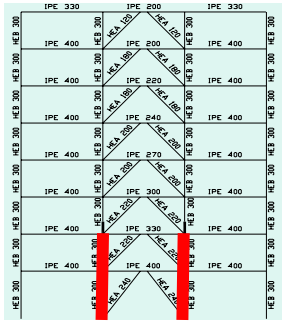
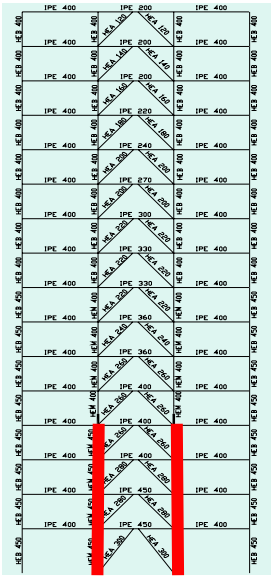
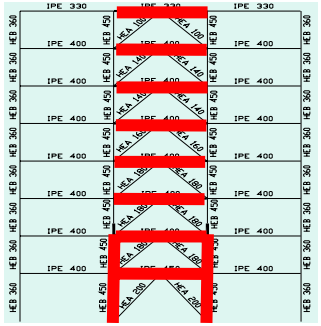
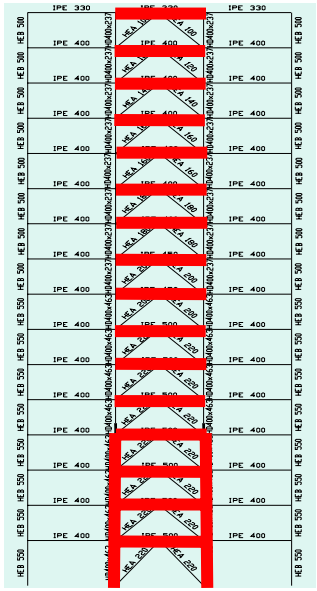
  "High-Performance Steels for Buildings Located in High Seismic Areas – STOPRISC", funded by the Ministry of Education and Research of Romania

# HSS applications to buildings in seismic areas

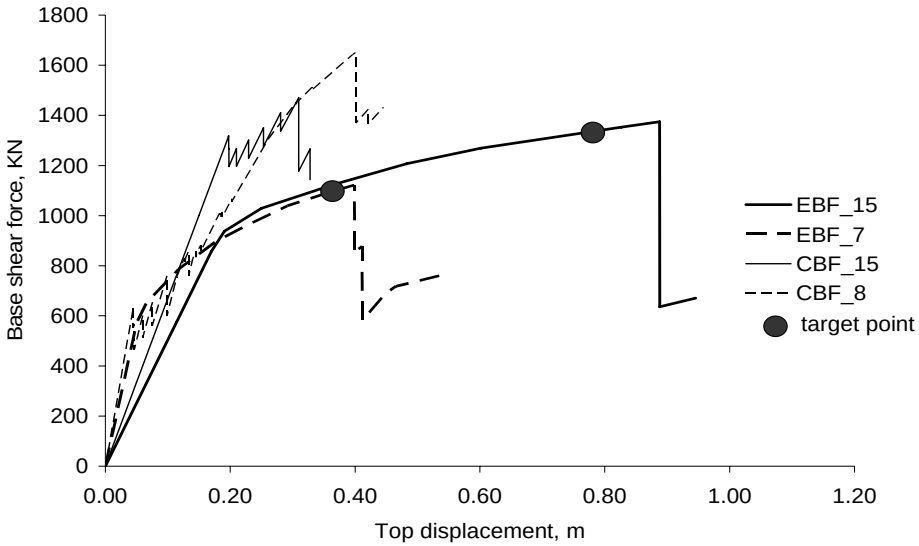
- S235, S355 and high resistance S460 steel grade
- Study of the possibility of using HSS in seismic resistant buildings:
  - numerical analyses on different frame typologies
  - experimental/ numerical simulations on connection details
  - experimental/ numerical simulations on MR joints
- Frame typologies
  - Moment Resisting Frames (MRF) of 5 and 11 storeys
  - Dual Frames with Eccentric inverted V-Bracing and short horizontal link (EBF), of 8 and 16 storeys
  - Dual Frames with Concentric inverted V-Bracings (CBF), of 8 and 16 storeys

# HSS applications to buildings in seismic areas

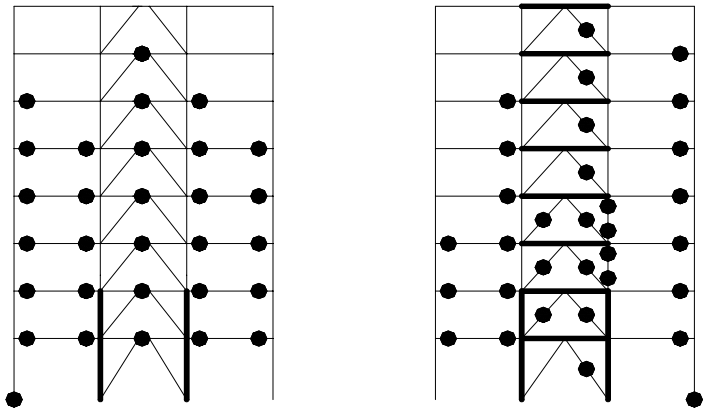
Frames were designed according to Eurocode 8 and the Romanian seismic code P100-2006

# HSS applications to buildings in seismic areas



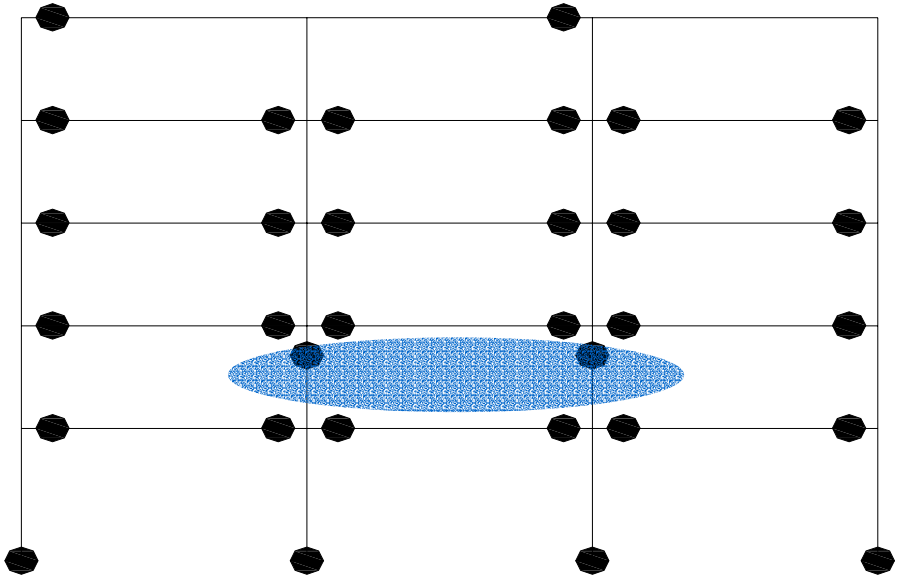

Base shear force vs. top displacement in the pushover analysis



Plastic hinges in the elements for the corresponding target displacements

# HSS applications to buildings in seismic areas

- MRF structures are generally designed by SLS criteria, thus the use of HSS may not be economical.
- However, for low-rise MRF structures with larger spans, strengthen of columns by using HSS may be necessary to avoid column failure in case of “near-collapse” state



# HSS applications to buildings in seismic areas

- Ongoing research activities
  - experimental/ numerical simulations on connection details
  - experimental/ numerical simulations on MR joints