Infrastructure as Art - Trans Urbanization
Prins Clausplein, Den Haag, The Netherlands

Design Guide - Dr. Karel Vollers
Technical Research Guide - Prof. Ir. C. Van. Weeren
Looking for a city on its edges, Characteristics of Polycentric Urban Region Under Constant Urban Pressure Global Competition

Randstad

Two Zones Identified as Future Metropolis
Den haag Vision 2020
Zone 3 - A4 Prins clausplein
Analizing Existing Developments

- La defense Paris, Business District
- Developed because of Introduction to efficient Metro, RER and Tramways.
- Suspended Over Fast road and Parking
Design Considerations - Future Perspectives

Design Considerations - Infrastructures As Art and Interaction

- Towards urban ready made shaping new environments
- A Parameter to generate Interactive spaces
Accessibility and Adaptation to live within Urban Environments?
Design Considerations - Automobile Industry Development
An Opportunity to co-exist

- Vehicles that communicate with traffic lights and other vehicles.
- Intelligence to find a free parking space and park in it automatically without a driver.
- Hybrid concepts, combustion engine and electrical engine.
- Fuel cell, Hydrogen + Oxygen = Electricity/H2O

Volkswagen Concepts 2028
Research and Developments in The Netherlands, Rome, Germany, UK

- Mobility demands cause an ever increasing pressure on the urban arena
- There is a need for innovative solutions to facilitate mobility
- Automated road transport may contribute to sustainability by a more efficient use of resources and space and increased transport safety.
Application – Heathrow Airport
Study Question? - Co Existence is the Key...

- How can innovative public transit systems provide new solutions for designing functional spaces within the Urban freeways, turning Infrastructure into a workable Public space?
Design - Transit Nodal Plan
Automated Tube Transport

- Horizontal elevators / Tube Bus
- Minimum 8 – 10 passengers

Home – Car – bus – office – bus - car
Related Design Parameters – Buffer Zone

- Plot/Site area is limited for Horizontal Plan.
- Future Road Developments.
- Physical Constraints – Safety/Pollution
Installation of Automated Sky Bus

- Dual Track more space for structure
- Single Track better Integration along critical Building Line

Integrated Sky bus within the Building
Better User Interface/Adaptation
The Sky bus System provides a Buffer Zone / Physical Diffuser
Integration of Overall Design
Shaping Parameter

• Highway Interface Parameter

• Shape reacting to different speed intensities and overlapping of Bridges

• Tubes ranging from 8 to 16 meters in radius which is the width of the Highway roads

• These shaping tubes are an interactive parameter resembling the physical relation of the building from the Highway.
Design Developments

- Defining Transit Character of the Design
- Vertical Transport
Functional Zoning

- Proposed Mixed use planning
- Efficient use of the Proposed Sky Bus Transit
- Buffer levels and User requirements
Detail of Station
Housing Design
Shopping and Leisure Design

- Indoor Recreation
- Large Open spaces
- Shops and cafes
- Continuity for Pedestrian Transport/Automated walkways

Offices - Interactive lift lobbies.
References.

Ground water heat and cold storage – Office building Rijkswaterstaat / Paul de Ruiter

Mixed Mode Ventilation – ING Building Amsterdam
• How can technical innovations in concrete be applied to create innovative/Complex structures which can facilitate the design of freer and more ambitious projects?

Initial Concept sketches

The Research Refers to

The second international symposium on Ultra High Performance Concrete
Kassel Germany March 5-7 2008

A new formulation approach by using ultra-fines materials supported by strong development of new admixtures open the way over the last twenty years to amazing processes in concrete technology.

A technological breakthrough took place at the turn the 90’s with the development of the said Reactive Powder Concrete (RPC) [1], offering compressive strength exceeding 200 MPa and flexure strength over 40 MPa, showing some ductility.
Based on the **RPC initial research**, further technologies were then developed.

1. **Ductal® Technology** – LAFARGE Paris, France

   Mechanical properties are achieved by using **short steel fibres**. A content of 2% **volume of 13-15mm** length fibres **Diameters around 0.2mm** is considered optimum till date.

   Minimizing Micro Cracks and Pores

   **Virtual Image**

   **Natural Image**

   **Greater Bending strength**

   **Greater Compressive strength**
Key Issues

Small Constructions - UHPC without reinforcement can be applied to small constructions
Medium or Large Constructions - Additional Reinforcement/Pre tensioning/Post tensioning

The elimination of **passive reinforcement** makes it possible to use **thinner sections** and a wider use of innovative and acceptable cross sectional shapes.

**Example 1- Toll Gate Millau Viaduct**

**Twisted sheet 98 m x 28m**

54 Differently shaped segments
0.60 to 2.0 meters High
Prefabricated – Bolted – Longitudinal Pre tensioning

Maximum applications of Pretensioned UHPC is in the Bridge Construction Industry
Choosing Criteria

1. Day light
2. Spatial Use
3. View to surroundings

Directly related to the distance between structural members and their Orientation.

• Concrete columns + shear concrete core
• Concrete skin + shear concrete core
• Concrete skin/shells
Shear wall Option

Series of concrete walls

- Optimization to Minimize material /Thickness
- High Compression at bottom
- Stress Concentrations
- Pre tensioning for Lateral movement
Design Optimization
Simulation - Physical Model
• Technical Data Input

Material Properties **High Strength Concrete**
Young’s Modulus $E = 3 \times 10^3$ N/m$^2$
Density $\sigma = 2400$ kg/m$^3$
Poissons ratio $\nu = 0.2$
Maximum permissible tensile stress = 3 Mpa = $3 \times 10^3$ N/m$^2$
Maximum permissible Compressive stress = 35-50 Mpa

Material Properties **Ultra High Performance Concrete**
Young’s Modulus $E = 5 \times 10^3$ N/m$^2$
Density $\sigma = 2500$ kg/m$^3$
Poissons ratio $\nu = 0.2$
Maximum permissible tensile stress = 8 Mpa = $8 \times 10^3$ N/m$^2$
Maximum permissible Compressive stress = 150-180 Mpa
**Test Condition 1** High Strength Concrete: 250 mm thick Shear walls with no openings
Combined Load case 1+2

**Test Condition 2a** High Strength Concrete: 250 mm thick Shear walls with openings
Load Case 1 (Pay Load a+ Dead Load)
Results

For Load Case 1 (*Dead load + Payload*) The Resulting Deflections, Local Stresses and Distributed Forces are within the ultimate stress capacities of High strength concrete which is used widely for various Architectural projects in present situation.

For Load Case 2 (*Dead Load + Payload + Wind Load*) the structural system shows increased deflections for, the Stresses are above the ultimate stress capacity of Present day concrete. But the stresses are well within control and further improvements by stiff floor construction and the ductility effect by adding conventional reinforcement or pre stressing will make it possible to use the structural system effectively.
• **Mass Damping effect** – In Test Condition 1 without openings maximum deflection in the Shear walls is 7 cm but In Test Condition 2c with openings the deflection increases to 14 cm.

• **Wind Load effect** – In Test condition 2a for shear wall with openings, without applied wind load the Deflection is 9 cm but in Test Condition 2c with applied wind load the deflection increases to 14 cm.
Floor Stiffness Effect – The in plane stiffness of the floors appears to have a significant effect on the structural behaviour. In addition to the steel beams, a floor slab 200mm thick was introduced.

Modulus of Elasticity

In Test Condition 3a Further Simulation with UHPC (improved ductility/Young’s Modulus) Shows Effective improvement in reducing the Deflection. Test condition 2c with, E= 30Mpa Max Displacement = 14 cm Test condition 3a with, E= 50Mpa Max Displacement = 8.5 cm

The Bending Moments at critical section is also reduced due to improved ductility.
• Advantage of High Performance concrete is not for the stability of the shear wall.

• Improved ductility/Young’s Modulus can be obtained by providing appropriate steel reinforcement and design.

• Stability with increased thickness of the shear wall, widened and narrowed till the ultimate strength limit of the applied concrete mix.

• The concrete mix can be further altered to achieve the desired strength capacities.

• Building Function requirements

• Steel fibers with appropriate proportions can be used as a means to minimize random cracking especially in thinner concrete members.
Remarks Design Research

• Integration of light and clean transit systems - avoid construction of tram stops and bus stops.

• Mixed use design of buildings is promoted - diversity within the end users of the transit facilities.

• A level of horizontal transparency is achieved since bus stops and tram stops are open visible entities of a city, which will encourage interactive atmosphere within the city communities.

• If new transport systems are moving ahead with cleaner operation, there is a need for new design strategies.
A Conceptual Proposal

- Advantages and disadvantages
Thankyou !!!
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