Steel Fiber Solutions for Shotcrete

Steel Fiber Reinforced Concrete (SFRC) provides several advantages in terms of structural performance, construction practicality, speed of construction and cost reduction over conventional reinforced concrete.

SPAJIC

Premium High Strength Steel Fiber

ZSN 0.50x30,35
ZSN 0.55x30,35
ZSN 0.60x30,35

Structural Advantages

- improves performance of concrete section under direct tension, flexure, shear and torsion
- increases fatigue endurance and impact resistance
- improves crack resistance
- random distribution throughout concrete mix

Performance

- improves ductility of concrete under loading
- increases toughness/energy absorption capacity
- improves concrete durability

Economic Advantages

- minimizes labour cost
- eliminates need for time-consuming manual steel placement and handling of reinforcement
- in-place cost is up to 50% less than mesh reinforced shotcrete
- provides increased ultimate load-bearing capacity which allows reduction of concrete section

Application

Substantial Daily Manufacturing Capacity

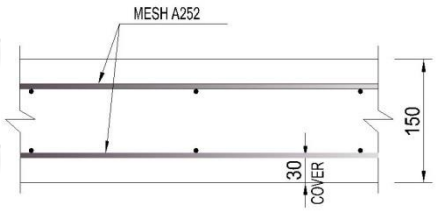
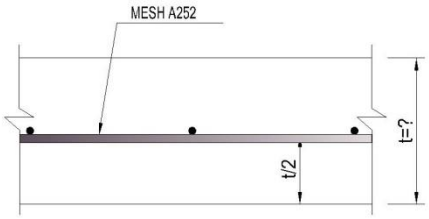
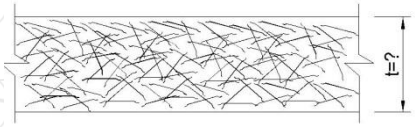
- support of underground openings in tunnels and mines
- rock slope stabilization and support of excavated foundation in combination with soil anchors
- construction of vertical retaining walls in combination with anchoring to basement walls
- concrete repairs

P.O. Box: 53023, Abu Dhabi, UAE
Mobile: (971) 50 4456913,

Email: office@spajic.com, www.spajic.com
sfrc@almgroup.ae, www.almgroup.ae

Comparative Design for Steel Fiber Reinforced Shotcrete vs Single and Double Mesh Reinforced Shotcrete

Design comparison to achieve same ultimate bending moment capacity

Double Mesh Reinforced Shotcrete	Single Mesh Reinforced Shotcrete	Steel Fiber Reinforced Shotcrete
		
$M_u=0.9\cdot d\cdot A_s\cdot f_y$ – ultimate moment d – slab thickness a – cover to steel A_s – area of steel f_y – characteristic steel strength for t = 150mm d = 150-30-8 = 112mm $A_s = 252mm^2/m'$ $f_y = 460N/mm^2$ $M_u=0.9\cdot112\cdot252\cdot460/1e6$ **$M_u=11.7kNm/m'$**	$M_u=0.9\cdot t/2\cdot A_s\cdot f_y$ for $M_u=11.7kNm/m'$ $A_s = 252mm^2/m'$ $t= 2\cdot M_u/[0.9\cdot A_s\cdot f_y]$ $t=2\cdot11.7e6/[0.9\cdot252\cdot460]$ **t = 225mm**	Spajic fiber ZSN 0.55x35 Dosage $50kg/m^3$ $R_{e,3}=84$ Concrete class C35/45 $f_{ck}= 35\ N/mm^2$ $f_{ctm,fl}= 5.1\ N/mm^2$ $f_{e,3}= R_{e,3}\cdot f_{ctm,fl}$ – residual flexural strength $f_{e,3}=84/100\cdot5.1=4.28\ N/mm^2$ $\Upsilon_m= 1.0$ – material safety factor $M_u=[f_{e,3}/\Upsilon_m]\cdot1000\cdot t^2/6$ $t=\sqrt{[6\cdot\Upsilon_m\cdot M_u/(1000\cdot f_{e,3})]}$ **t = 130mm**
Material usage Concrete volume $0.15m^3/m^2$ Steel 7.9 kg/m^2 ($53\ kg/m^3$)	Material usage Concrete volume $0.225m^3/m^2$ Steel 4.0 kg/m^2 ($18\ kg/m^3$)	Material usage Concrete volume $0.13m^3/m^2$ Steel fiber 6.5 kg/m^2 ($50\ kg/m^3$)
Main features • difficult, time-consuming, costly and often hazardous installation of reinforcing mesh in tunnels • high shotcrete consumption due to irregular rock/soil surface and filling of voids/cavities	Main features • difficult, time-consuming, costly and often hazardous installation of reinforcing mesh in tunnels • high shotcrete consumption due to irregular rock/soil surface and filling of voids/cavities • concrete section prone to cracking	Main features • crack-free concrete • rapid construction • ductal, tough and shock-resistant concrete section • in-place costs are up to 50% less than mesh reinforced shotcrete although SFRC per m3 is more expensive.

Detailed Design to
TR63, ACI544, FIB, RILEM
Eurocode EN 1992-1-1:2005-11

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Compliance

- Conforms to EC-EN14889-1, Type 1 cold drawn wire

Certificates

Dosing and dispensing equipment

- High capacity heavy duty automatic dosing machine

Packaging

- Store in dry area. Do not stack pallets on top of each other.
- Pallets wrapped in plastic film.

Spajic DOO
Milosevski put bb,
19300 Negotin, Republic of Serbia
T:+381.19.542.630
F:+381.19.549.774
info@spajic.com, office@spajic.com
www.spajic.com

Technical assistance on selection of fiber type and dosage to meet project performance criteria.