The Steel Braced Concrete Shear Core

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LCL Builds Corporation, Toronto, CANADA
Steel Braced Concrete Shear Core

A new approach to Structural Frames for High Rise Office Buildings

Canadian Patent No. 2,471,807
US Patent No. 7,444,793
International Patent Pending
Steel Braced Concrete Shear Core

We have invented a better, faster way to build concrete shear cores for steel framed office buildings. We are here to show you:

- How you can reduce your construction time of a typical 20,000sf floor plate office building, by more than 2 1/2 days per storey;
- How to reduce your structural construction costs by approximately 5%;
- The details of the Steel Braced Concrete Shear Core;
- Comparisons of different structural frame types.
Case Study

Meydenbauer

A 22-Storey, 412,000 sq. ft. Office Building in Bellevue, Washington
MEYDENBAUER
OFFICE TOWER ONE
TYPICAL ARCHITECTURAL FLOOR PLAN
Conventional Construction of the Concrete Shear Core
Phase II Steel Erection Underway
Why is the Conventional Concrete Shear Core Popular?

- No structural steel bracing or moment connections
- Lowest lbs/BSF structural steel
- Column-free tenant space
- High performance, stiff building
Disadvantages of the Conventional Concrete Shear Core Frame

- Extended construction duration
  (Have to build the core in advance of the building)

- Multiple structural steel erection mobilizations

- Have to rebuild the core forms at storey height transitions
Disadvantages of the Conventional Concrete Shear Core Frame (cont.)

- Redundant construction equipment is needed: Additional man hoist, temporary stair tower
- The self-climbing or jump form system is expensive
- The sequence and flow of the finish building trades that follow the steel erection do not keep pace with the steel erection
The Steel Braced Concrete Shear Core

vs.

The Conventional Concrete Shear Core
MEYDENBAUER
STEEL BRACED CONCRETE SHEAR WALL ERECTION

LEVEL 10 FRAMING

LEVEL 2 SHEARWALL

LEVEL TWO HORIZONTAL CONCRETE

STEEL DECK AND PARTIAL FRAMING REMOVED TO EXPOSE HORIZONTAL CONCRETE AND SHEAR CORE
MEYDENBAUER

STEEL BRACED CONCRETE SHEAR CORE vs. CONVENTIONAL CONCRETE SHEAR CORE

• ELEVATORS READY TO START

DAY 50

STRUCTURAL STEEL TOPPED OUT

CONCRETE CORE TO FLOOR TEN
MEYDENBAUER
STEEL BRACED CONCRETE
SHEAR WALL ERECTION

LEVEL EIGHTEEN SHEAR WALL

LEVEL SIX FAÇADE

STEEL TOPPED OUT

LEVEL EIGHTEEN HORIZONTAL CONCRETE

STEEL DECK AND PARTIAL FRAMING REMOVED TO EXPOSE HORIZONTAL CONCRETE AND SHEAR CORE
MEYDENBAUER

STEEL BRACED CONCRETE SHEAR CORE vs. CONVENTIONAL CONCRETE SHEAR CORE

• EXTERIOR FAÇADE COMPLETE TO FLOOR 11
• ELEVATORS IN 6th WEEK OF PROGRESS

DAY 80

CORE AT FLOOR 17 STRUCTURAL STEEL STARTS
MEYDENBAUER

STEEL BRACED CONCRETE SHEAR CORE vs. CONVENTIONAL CONCRETE SHEAR CORE

DAY 100
MEYDENBAUER

STEEL BRACED CONCRETE SHEAR CORE vs. CONVENTIONAL CONCRETE SHEAR CORE

• CONSTRUCTION USE ELEVATORS ARE ON LINE

• EXTERIOR FAÇADE ON 19th FLOOR

• FOR CONVENTIONAL CONCRETE CORE, TOP OUT OF CORE IS TIMED TO COINCIDE WITH STRUCTURAL STEEL TOP OUT

• ELEVATORS READY TO START

DAY 120

Shear Core topped out
## MEYDENBAUER SCHEDULE COMPARISON

### Steel Braced Concrete Shear Core vs. Conventional Concrete Shear Core

<table>
<thead>
<tr>
<th>Concrete Core</th>
<th>12 Day, 6 Floor Lag</th>
<th>7 Weeks</th>
<th>3 Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 17</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

- **Concrete Core**: Follows steel erection pace, 7 floors below
- **3 Weeks to start, then one week per storey**

<table>
<thead>
<tr>
<th>Structural Steel Erection</th>
<th>3 Weeks</th>
<th>9 Weeks</th>
<th>Roof</th>
</tr>
</thead>
</table>

- **3 Weeks to start, then one tier every four days**

<table>
<thead>
<tr>
<th>Total Building Structure Erection Time</th>
<th>15 Weeks</th>
<th>1 Week to start, then 1 tier every 3 days</th>
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<tbody>
<tr>
<td></td>
<td>(11 ½ Weeks Time Savings)</td>
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</tbody>
</table>

- **26 ½ Weeks**

### Elevators

- **Can start at week 13**
- **Can start at week 27**
# MEYDENBAUER
## COST COMPARISON

<table>
<thead>
<tr>
<th></th>
<th>Steel Braced Concrete Shear Core vs. Conventional Concrete Shear Core</th>
<th>Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shear Core Form and Place</strong></td>
<td>• Delete self climbing form system</td>
<td>&lt;$935,000&gt;</td>
</tr>
<tr>
<td></td>
<td>• Delete 10 levels of vertical rebar laps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Delete form savers</td>
<td></td>
</tr>
<tr>
<td><strong>Structural Steel</strong></td>
<td>• Add 8 erection columns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Add 6 erection beams per floor</td>
<td>$1,188,000</td>
</tr>
<tr>
<td><strong>Construction Personnel Movement</strong></td>
<td>• Delete personnel hoist in core</td>
<td>&lt;$320,000&gt;</td>
</tr>
<tr>
<td></td>
<td>• Delete construction stairs in core</td>
<td></td>
</tr>
<tr>
<td><strong>General Conditions</strong></td>
<td>• 11 Weeks time savings @ $36,000/Wk</td>
<td>&lt;$396,000&gt;</td>
</tr>
</tbody>
</table>

**Sub Total** $<$463,000>
(11 weeks and $21,000 per story)

**Developer Savings**
• 11 Weeks interest carry
• 11 Weeks earlier rent income

**Total Savings** $<$1,963,000>
# MEYDENBAUER
## STRUCTURE OPTIONS

Study Parameters:
- 22 Stories
- 412,000 gsf

<table>
<thead>
<tr>
<th>Frame Description</th>
<th>Optimum Column Spacing</th>
<th>Floor to Floor for 9'-0 Ceilings</th>
<th>Façade Impact (at $42 / SSF)</th>
<th>Tenant/Interior Flexibility</th>
<th>Tower Structure Construction Time</th>
<th>Cost / BSF Premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Shear Core with Suspended Steel Framing</td>
<td>30 x 45</td>
<td>12'-6</td>
<td>Baseline</td>
<td>Column-Free Tenant Space</td>
<td>26 Weeks</td>
<td>Baseline</td>
</tr>
<tr>
<td>Steel Braced Concrete Shear Core with Suspended Steel Framing</td>
<td>30 x 45</td>
<td>12' –6</td>
<td>Neutral</td>
<td>Column-Free Tenant Space</td>
<td>15 Weeks</td>
<td>&lt;0.86&gt;</td>
</tr>
<tr>
<td>Concrete Shear Core w/PT Flat Plate (Core Walls 42” thick)</td>
<td>30 x 30</td>
<td>11'-8</td>
<td>Saves 500 sf/floor ($1.07/bsf)</td>
<td>Columns in Tenant Space Structure bulk consumes an extra 250 sf usable space per floor Tough Floor Penetrations</td>
<td>34 Weeks</td>
<td>$1.13</td>
</tr>
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<td>Frame Description</td>
<td>Optimum Column Spacing</td>
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<tr>
<td>Concrete Shear Core w/PT Beams and Slabs</td>
<td>30 x 40</td>
<td>12'-2</td>
<td>Saves 200 sf/floor ($0.43/bsf)</td>
<td>Structure bulk consumes an extra 200 sf usable space per floor</td>
<td>34 Weeks</td>
<td>3.04</td>
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<td>Tough Floor Penetrations</td>
<td></td>
<td></td>
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<tr>
<td>Composite, Steel Pipe Column Core with Suspended Steel Framing</td>
<td>30 x 45</td>
<td>12' -6</td>
<td>Neutral</td>
<td>Bulky core impacts elevator layouts</td>
<td>14 Weeks</td>
<td>.95</td>
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<tr>
<td>Structural Steel Brace/Moment Frame (Dual System)</td>
<td>30 x 45</td>
<td>12'-6</td>
<td>External Cross Braces Visible</td>
<td>Bracing Impacts</td>
<td>12 Weeks</td>
<td>4.00</td>
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</tr>
<tr>
<td>Structural Steel Perimeter Moment Frame (SMRF)</td>
<td>20 x 45</td>
<td>12'-6</td>
<td>Neutral</td>
<td>Column-Free Tenant Space</td>
<td>12 Weeks</td>
<td>8.75</td>
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</tbody>
</table>
The Steel Braced Concrete Shear Core Details are simple
TYPICAL TWO STOREY TIER STRUCTURAL ERECTION SEQUENCE

DAY ONE
1. TWO STOREY SHEAR CORE ERECTED.
2. TWO STOREY FRAMING ERECTED ADJACENT TO CORE
DAY TWO

1. 50% OF TWO STOREY STEEL FRAMING COMPLETE.

2. METAL DECK 50% SPREAD ON UPPER DECK, STOCKED ONLY ON LOWER DECK.
TYPICAL TWO STOREY TIER STRUCTURAL ERECTION SEQUENCE

DAY THREE

1. ALL STEEL ERECTED.

2. METAL DECK 75% COMPLETE ON UPPER DECK.

3. METAL DECK STOCKED ONLY ON LOWER DECK.
TYPICAL TWO STOREY TIER STRUCTURAL ERECTION SEQUENCE

DAY FOUR

1. METAL DECK 100% PLACED.
2. SHEAR STUDS IN PROGRESS.
3. TWO STOREY STRUCTURE ERECTION COMPLETE.
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STEEL BRACED CONCRETE SHEAR WALLS: PLANS AND DETAILS

Sketch 1
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HOISTING ELEVATION

Meydenbauer - Office
STEEL BRACED CONCRETE SHEAR WALLS: HOISTING ELEVATION
MEYDENBAUER
CONCRETE FORMING SYSTEM

NOTES
- SIMPLE SINGLE WALER FORM SYSTEM
- FORMS BELT ON CONCRETE FLOOR
- OUTSIDE FORM ENDS AT BEAM SOFFIT
- NO ROOF FORM ON SHEAR WALL WHICH SAVES SIGNIFICANT LABOR
- CYCLES AT SAME TIME AND ECONOMICAL AS SLAB ON METAL DECKING

4000 PSI 2-1/2" CONCRETE SLAB OVER 3" METAL DECKING

W11 STUDIED ERECTION BEAM
STEEL CONNECTOR PLATE REMOVED IN CONCRETE
HANDBIT TWO-SIDED FORM SYSTEM
6000 PSI 24" CONCRETE SHEAR WALL

Meydenbauer - Office
STEEL BRACED CONCRETE SHEAR WALLS: CONCRETE FORMING SYSTEM
Steel Braced Concrete Shear Core

Summary

- This construction method is practical for office buildings taller than 20 storeys.

- The erection columns are redundant and sized to support 10 storeys of steel erection.

- Easier, faster out of the ground. No complicated rebuilding of forming systems at storey height changes.

- The concrete shear core in a high rise building is one of the most cost-effective designs to provide building frame lateral stability.
Summary (cont.)

- The concrete shear core provides an excellent area of refuge for tenants.

- With the steel braced concrete shear core, designers no longer have to be concerned with locating stairs or elevators inside the core for construction efficiencies.

- A separate operated Man/Material hoist is not needed for the concrete core construction.

- Permanent building elevators are on line before the conventional concrete shear core has topped out.

- Structural tolerances inside the concrete core are easier to manage.
Summary (cont.)

- No waiting or demobilization of the steel erection during the concrete core construction. All construction activities follow the pace of the structural steel building erection.

- The elaborate concrete core forming system is not needed. The construction systems employed in the steel braced concrete shear core are very simple.

- The construction time savings over a conventional concrete shear core starts at 2 ½ days per storey and increases with additional building height.

- The structural construction cost savings over a conventional concrete shear core starts at approximately 5% for a 20 storey building and increases with additional building height.
We want to be a member of your building team.
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Thank you