Steel truss outrigger systems are an ef cient structural response to increased urbanization and the resulting bigger (and hopefully better) buildings.

steelwise

RIGGED FOR THE FUTURE

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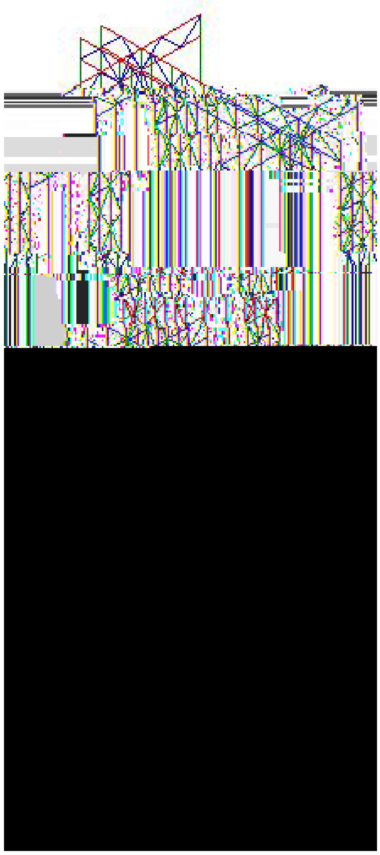

▲ A conventional outrigger system.

➤ A virtual outrigger system incorporating a hat truss and a belt truss.

added incrementally until the drift requirement is satisfied, at which point the designer can go back and start reducing member sizes outside of the truss zone. Additionally, virtual work optimization techniques are often useful in guiding the engineer on how to most efficiently distribute loads and optimize member sizes.

One common practice is to locate the outrigger trusses at the mechanical level(s) of the building. As mechanical levels typically don't require the unobstructed space that an office or apartment floor plan would, trusses can span across the entire floor plate without disruption. In addition, mechanical levels are often double-height spaces and therefore can accommodate a deeper truss. Another alternative is to align corridor walls with the trusses. Early coordination between the architect, engineer and other relevant parties can allow the design team to align door openings under braces. The trusses can be hidden from view and still provide total functionality to the space. Regardless of the approach taken, early collaboration will surely provide for a more optimized and economical solution.

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Steel is adaptable, and in the absence of a mechanical level or an ideal layout for a conventional outrigger system, a virtual outrigger can be a great solution. In a virtual outrigger system, the trusses are not directly connected to the core, yet the same concept of moment transfer from the core to elements outboard of the core still applies. Floor diaphragms are used to transfer moment in the form of a horizontal couple from the core to the trusses. The trusses then convert the horizontal couple into a vertical couple in columns outboard of the core.

With a steel braced frame core, transfer of forces between the core and the floors can be achieved through shear studs on horizontal frame members. As many modern-day buildings use slimmer floor slabs that may not be as stiff, the designer may also want to consider using horizontal bracing beneath the floor to transfer the load. This would prevent stiffening of the slab at particular levels and irregularity in floor construction.

Virtual outriggers also have greater flexibility in location. Since a conventional outrigger is typically located at a mechanical level, it is not necessarily in a position to completely optimize its stiffening potential. A virtual outrigger is typically not subject to these same constraints and therefore can be placed at the height of maximum effectiveness. Since a virtual outrigger does not typically produce as large of a stiffness increase as a conventional outrigger does, maximizing location effectiveness can help offset this.

But wait, there's more!

A steel core and outrigger system can do more than just increase stiffness and reduce drift. There are some great secondary bene ts as well. In a core-only tower, the relatively short distance between resisting elements results in low torsional-stiffness. (If your building model animation has ever looked like it is taking an aerobics class when subjected to wind load, then you may be familiar with this problem.) Incorporating an outrigger system, particularly at the perimeter, can provide a signi cant increase in torsional stiffness and reduce some of that twisting and turning.

Outriggers can also be helpful when progressive collapse needs to be considered for a project. If there is a need to analyze the effect of the sudden loss of a local member, outriggers can provide alternate load paths. In cases where perimeter columns are engaged by belt trusses, loads